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No. VII.

Geological Survey of Victoria.

REPORT OF PROGRESS,

BY THE

SECRETARY FOR MINES,

WITH

REPORTS ON GEOLOGY, MINERALOGY, MINING, AND THE PHYSICAL STRUCTURE OF VARIOUS PARTS OF THE COLONY,

BY

REGINALD A. F. MURRAY,	ALFRED J. AGG,
J. COSMO NEWBERY,	A. W. HOWITT,
FREDERICK McCOY,	JAMES STERLING.

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SECTION I.

REPORTS RELATING TO GOLD-FIELDS AND PROBABLE AURIFEROUS AREAS.

Prefatory Remarks.

The labours of the Geological Surveyor during the past four and a half years have been mainly directed to mapping the topography and geology of areas presenting features of special mining interest, such as the gold-fields of Eaglehawk, Reedy Creek, Clunes, Mount Greenock, and Talbot, and the country around Rodborough, through which latter locality pass the extensions of the Creswick and Smeaton deep leads.

From time to time, as occasion has arisen rendering it desirable that information be obtained concerning the mining prospects of any district, or that any discovery of supposed importance be inquired into, the regular work has been temporarily suspended so as to admit of the necessary inspection being made.

The objects kept in view in the execution of all such regular or special duties have been to increase, as far as possible, the fund of scientific and practical knowledge of the geology and mining resources of the colony, to direct enterprise into channels where scientific data indicated the most reasonable hopes of success, and to prevent expenditure in directions where those data afforded little or no ground for such hopes.

In collating for publication the results of the investigations made, the material has been classed in four sections :—

I. Gold-fields and probable auriferous areas.
II. The progress of development of coal mining.
III. The search for artesian water supplies.
IV. Discoveries of marble and limestone.

In the first section are contained the results of investigation, and expressions of opinion arising therefrom, as to the geology and probable auriferous character of a number of different localities. The survey of the extension of quartz reefs northward from Eaglehawk was made, and the accompanying descriptive report furnished at the request of the Borough Council of Eaglehawk. In executing this work, it was endeavoured to give it as practical a bearing as possible, and to prepare the plan and notes in such a manner as to be of use either to prospecting diggers or to those proposing extensive mining enterprise.

The examinations of portions of the country around Wangaratta, Benalla, Rutherglen and Wahgunyah were made at the instance of members of the Borough Councils, and of residents interested in the mining development of the respective localities.

A reference to the reports will show that in some cases the geological indications were found to be such as to inspire encouragement, while in others the chances of success appeared doubtful.

The tide of speculation which was for some time directed towards the quartz reefs of the Reedy Creek gold-field, rendered it advisable that a plan and descriptive report should be prepared for public information.

The plan was printed, and the report was made available for publication in the columns of the Press as soon as sent in; they are here republished as portions of the record of the work executed.

The first of the reports on the country around Gembrook was furnished at the request of a deputation of some of the leading residents. The second examination was made with a view to ascertain what claims, if any, the Crichton's Freehold Gold Mining Company might possess to participate in the distribution of the prospecting vote. The expressions of opinion by Mr. A. W. Howitt, P.M. and Warden, and by the Geological Surveyor, as to the probable existence of auriferous gravels beneath the basalt west of the Thomson River, were obtained at the instance of Mr. A. Harris, M.L.A., by request of residents of Walhalla.

Special interest attaches to prospecting operations beneath the basaltic areas of Gembrook and the Thomson River, for, if successful, they will lead to the careful testing, with equally good chances of success, of extensive tracts of similar character between the two localities.

The papers on the deep leads of the Loddon Valley, on the geological surveys of the Clunes, Mount Greenock, Talbot, and Rodborough districts, and the geological maps thereof, now in course of publication, embody the results of the regular work that has been in progress during the past three years.

So far as geological indications afford grounds for opinion as to the auriferous quality of untried areas, the data supplied by these reports and maps give reason for encouraging hopes as to the future mining prosperity of portions of the district surveyed.

The report on the extension of the Stawell leads, and the probabilities of further quartz discoveries in the district, or of coal being found in the Grampian sandstones, was obtained in compliance with the request of the

Mayor and residents of Stawell, and in framing the report it was specially endeavoured to direct proposed mining exploration to localities where the geological indications and ascertained mining facts gave the strongest grounds for hopes of success.

The report on the Bacchus Marsh district was furnished at the request of a large number of residents, who desired some information as to the probable resources of the district with respect to gold, coal, and artesian waters.

The report on the Howqua Hills country was made at the instance of the Howqua Shire Council and residents interested in the development of mining and the improvement of the roads through the less inhabited portions of the district.

One main result of all the various examinations made throughout the colony has been to substantiate the theory that gold occurs in payable quantities only within certain belts of Silurian strata, the intervening zones being poor or barren; that these belts, varying in direction according to the strike of the rock-layers, maintain their respective qualities, with trifling local interruptions, across the entire breadth from south to north of the exposed Lower Palæozoic area of Victoria.

Were a map of the colony prepared showing in some bright colour the areas actually proved auriferous, that colour would appear as a succession of more or less parallel, and occasionally broken stripes, extending from the sea-board or the margin of the low Tertiary country on the south to the margin of the Murray Tertiaries on the north, and the bearing of the stripes would be found to coincide with the strike of the Silurian rocks in the respective localities.

To thoroughly work out and establish this theory will necessarily occupy considerable time and study, but its practical application can even now be made serviceable to a certain extent as a guide in gold prospecting, and a reference to some of the reports will show how, and to what extent, it may be usefully applied.

REPORT ON THE MEANS OF TESTING THE EXTENSION OF THE MYER'S FLAT LEAD.

Department of Mines,
Melbourne, December 16th, 1879.

SIR,

With reference to your communication conveying to me the desire of the Eaglehawk Borough Council that I should report as to the best means of testing the extension of the Myer's Flat Lead, I have the honour to inform you that when at Eaglehawk I examined the locality. The Myer's Flat gold-workings appear to run out near the junction of Sydney Flat. The alluvial deposits increase in width northward, and it is probable the gold in them becomes more scattered. At the same time it is likely that the quartz reefs whence the alluvial gold of Sydney Flat and its western tributaries was derived, may extend northward beneath the alluvial deposits, which may be auriferous in their vicinity. The only way to prospect would be to sink a series of holes a short distance ahead of the workings, across where the Flat narrows slightly, immediately below the junction of Sydney and Myer's flats. Another line of holes could be sunk a mile further north between the Barkly Reef and the opposite side of the Valley. As the alluvial deposits are fully a mile wide, a number of holes would be required, but, as far as I can learn, the sinking is neither deep, difficult, nor much impeded by water, as far as workings have extended.

Most of the land appears to be private property, so that, in the event of prospecting operations being eventually carried on, special arrangements would have to be made with the proprietors.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

REPORT ON SURVEY OF EXTENSION OF QUARTZ REEFS NORTHWARD FROM EAGLEHAWK, SANDHURST.

Office of Mines,
Melbourne, 13th December, 1879.

SIR,

Description of plans. I have the honour herewith to submit a plan showing the topographical features, the alluvial gold-workings, the surface outcrops of quartz reefs, and the most remarkable or persistent rock bands within a tract of country, 1½ mile wide, extending 3 miles northerly from the northern boundary of the Borough of Eaglehawk, near Sandhurst, and forming part of the country known as the Whipstick. Through this area run the prolongations of two of the principal lines of reef in the Sandhurst district: namely, the Lightning Hill Reef, supposed to be a continuation of the Hustlers line; and the Moon Reef, evidently an extension of the Garden Gully and Specimen Hill line. The lines projected for survey purposes, and those cleared on the apparent northerly extensions of the two reefs referred to, are shown on the plan.

Method of survey. The mode in which the survey was effected was as follows:—A main line, having a magnetic bearing of N. 20° W., approximating to the general direction of the strike of the quartz reefs and rock bands, was cleared for a distance of 3 miles from the trigonometrical survey station on Lightning (White Horse) Hill. Lines were then cleared at every quarter of a mile on, and at right angles to the main line, for

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distances of one mile westerly and half-a-mile easterly therefrom. All these cleared lines were projected with the theodolite and chained, the necessary labor for assistance in the work being provided by the Eaglehawk Borough Council. Besides taking notes on these lines, I then carefully surveyed the spaces intervening between them by means of the prismatic compass and pacing, methods sufficiently accurate for such short intervals.

The work being roughly plotted, the most probable lines of extension of the two reefs above referred to were blazed, and places marked on their intersections with the survey lines for the erection of posts.

Mr. Tolhurst, Town Clerk of Eaglehawk, undertook to have these lines properly cleared and posts erected, having painted thereon the names of the lines marked.

A prospector, having a copy of the plan and following the lines shown thereon, can identify his position, or proceed to a required point anywhere within the survey, knowing at the same time his position with respect to existing workings.

Bearing of strike, &c., of strata.

From the observations made during the survey, it appears that the general bearing of the strata and the quartz reefs is about N. 30° W. for the first mile of the survey, but that further to the northward the direction of strike gradually deflects and assumes a bearing of N. 20° W., coincident with that of the main survey line.

The two lines cleared on the apparent extensions of the Lightning Hill and Garden Gully reefs respectively, follow this deflection and show a remarkable parallelism to one another, notwithstanding that they are three-quarters of a mile apart.

These lines have been marked out on the apparent trend of the reefs with the nearest approach to accuracy possible under the circumstances; the outcrops of quartz and the strikes of adjacent rock bands having alone afforded indications for guidance in the work. Future mining operations may reveal local errors, but I believe that, as regards general direction, the lines will be found useful guides for prospecting.

Line cleared on extension of Lightning Hill Reef.

The line cleared on the Lightning Hill Reef starts from the first, or ¼-mile, cross line, 1½ chain westerly from the main survey line, close to the King of Prussia mine; it ends at the last, or 3-mile, cross line, at a point 19½ chains westerly from the main survey line.

The principal outcrop of the Lightning Hill Reef extends from the summit of Lightning (White Horse) Hill down to the King of Prussia Company's engine-house. There are in this distance (about ¼ mile) several auriferous "shoots," all of which appear to dip northerly. The eastern wall or "back" is very well defined, and has a bearing varying from N. 25° W. to N. 36° W. according to a number of bearings taken in the workings; occasional faults throw it to the west; its underlie is to the eastward. The quartz occurs in the form of a number of large and small veins and spurs, some richly auriferous and others nearly barren; the best stone hitherto found has been in the neighbourhood of the eastern wall. The true western wall does not appear to have been yet proved in the workings. In shafts sunk along the line northward from the King of Prussia, bodies of stone have been met with, but not, as yet, of a payably auriferous character.

For a mile beyond the King of Prussia mine the line of reef is very indistinctly marked by occasional surface outcrops, or "blows," and straggling veins of quartz; but it is worthy of notice that alluvial workings have been traced up to such outcrops in one or two places.

For a further distance of half-a-mile the apparent course is beneath the alluvial deposits of Deadman's and Centipede gullies.

Beyond the junction of these two gullies the outcrops on the line become more conspicuous and easily traceable across the ranges from gully to gully. A gully, the name of which I could not ascertain, has been well worked for alluvial gold up to the largest of these outcrops, on a range about 2 miles northward from the King of Prussia mine; and from where the line crosses the lower portion of Sardine Gully, just above its junction with Snowball Flat, a small run of alluvial workings extends for a short distance down the Flat. The main workings of Snowball, however, commence further westward from another line of quartz reef, which appears to be an extension of the Black Forest and Red Jacket lines.

Line cleared on extension of Garden Gully Reef.

The line cleared on the apparent extension of the Garden Gully Reef commences on the second or ½-mile cross line, at a distance 67½ chains westerly from the main survey line, and about 250 yards north-westerly from the Robin Hood shaft, extending to a point on the eleventh, or 2¾-mile, cross line 77½ chains from the main line. Beyond this the line would, for some distance, pass through alluvial flats occupied for farming. For the first 10 chains the quartz outcrops, and a characteristic sandstone band with quartz leaders, indicate the line of reef with tolerable certainty; it then becomes very indistinct for more than half-a-mile, after which the outcrops become and continue large and persistent to the extremity of the clearing. A parallel line, once known as the Undaunted, about 60 yards to the westward, has been worked from near the Robin Hood for half-a-mile to the north, and is now being worked at that end; but the outcrops on the Moon line are practically untested north from the Robin Hood workings. Surface appearances indicate the probability of these reefs coming together further to the north; they do not seem to have been prospected at all to the north of Beelzebub Gully, though the outcrops there are very strong and persistent.

Several of the gullies intersecting the two lines cleared have evidently been prospected for alluvial gold, but not worked; their character cannot, however, be said to have been definitely ascertained, considering how narrowly alluvial runs of gold may be missed by the prospector.

Points suggested for prospecting.

The gullies which have been profitably worked up to the lines certainly indicate that auriferous shoots exist in the reefs adjacent to where the alluvial "runs" commence, and these are the localities that should have most attention directed to them. On the Lightning Hill line, the places already referred to in Sardine Gully, and an unnamed auriferous gully 2 miles northerly from the King of Prussia mine, should be well tested. It would also appear that the alluvial workings of Beelzebub Gully and its eastern tributaries, though starting from lines of reef far to the eastward, gained an access of wealth westward of this particular line.

On the Moon, or Garden Gully line, auriferous alluvial deposits have evidently either headed from, or have been augmented in richness after crossing, the line as far as Beelzebub Gully. Beyond that the gullies crossed are in the form of tolerably wide flats, which do not appear to have been sufficiently prospected.

Other lines of reef.

Besides the two along which clearings have been made, there are many lines of reef within the area surveyed; but of these the only ones worked are the Black Forest Reef, the Red Jacket Reef, and Jacob's Reef.

Black Forest and Red Jacket lines.

An opinion is entertained by some that the Black Forest Reef, which is only distant about 300 yards from the Lightning Hill line, is the true continuation of the Hustlers line: and so far the balance of what little evidence can be obtained is in favour of the supposition. This reef is reported to have yielded very well in some places, while in others it has proved unremunerative. The Red Jacket Reef seems beyond a doubt to be a continuation of the Black Forest line, and is now being worked in a small way by a few parties. From the line of these reefs head various rich alluvial workings, as may be seen by reference to the plan. The outcrops continue well-defined and persistent northward to the workings of Snowball Gully, which appear to start from this line, thereby indicating its probable auriferous character in that locality. In fact I am disposed to regard this as more deserving of notice than the continuation of the Lightning Hill line.

Jacob's Reef.

In Jacob's Reef, whence the alluvial workings of Cricketer's Gully start, a rich "shoot" was worked some years ago, and a small party of men are now trying to recover it, or find another. The outcrops on this line are traceable southerly for 2 miles to Mosquito Gully, but are practically untested, though apparently the partial sources of several auriferous alluvial deposits. Other lines of quartz reef, more or less persistent, about 100 yards westward of the course of Jacob's Reef, appear to be the sources whence was derived the alluvial gold in the tributaries of Centipede Gully, the gullies running together at Fiddler's Green, Devil's, Skinflint, and Mosquito gullies, and some of the branches of White Horse and Opossum gullies.

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General remarks.

A very persistent, but in some places small, reef runs parallel with, and about 250 yards eastward from, the Moon or Garden Gully line. Some of the auriferous tributaries of Dead Horse Gully and Gluepot Gully head from this line, and also a short run of auriferous ground between the 2¼ and 2½ mile cross lines in the lower portion of the gully already referred to as heading from the Lightning Hill line. Several other lines of rather disconnected but sometimes large outcrops of quartz reef are the apparent sources of the alluvial gold in Wellington and other rich gullies.

The general character of the alluvial workings throughout the area surveyed indicates that the gold was derived from the wearing down of local reefs, and was not carried from more distant matrices. Hence, the fact of alluvial gold being traced up to the vicinity of a quartz reef, and no further, may be regarded as tolerably sure evidence that somewhere in that reef occur auriferous "shoots" of stone.

Although there is scarcely a reef which does not show, along some portions of its course, signs of having been tried by prospectors, those trials have been for the most part of a superficial character. Most attention appears to have been paid to the largest outcrops, or "blows," of quartz, and it is a matter of common experience that such bodies of stone are frequently barren within very short distances of rich spurs or leaders. The known tendency of gold to occur in separate "shoots" along lines of reef might frequently cause failure in prospecting, and to this alone may be ascribed the fact that so many apparently auriferous reefs remain unworked.

Except those recognised by locally acquired experience, there are no indications which could be with certainty followed for guidance in testing reefs. The presence of alluvial gold can be taken as a sure sign of the existence of an auriferous reef, but, to discover the latter, nothing but patient exploration by means of trenching, &c., will avail.

The opinion is confidently ventured that sooner or later the Whipstick will develop into a good reefing district, and that reefs at present unnoticed, because they are not on known lines, will be worked to advantage. Besides the portion mapped, the country generally from Lightning Hill to Flagstaff Hill, along the range connecting these two points, may be indicated as likely to reward properly conducted prospecting.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

Notes to accompany Plan showing the Surface Extensions of Quartz Reefs northward from Eaglehawk.

The main survey line starts from the trigonometrical station on the summit of Lightning Hill, whence the clearing through the scrub is distinctly visible.

The cross-lines have been cleared at every ¼-mile distance, as shown on the plan. They are distinctly traceable, the scrub being cleared and pegs driven at short intervals.

The lines on the apparent extensions of the Lightning Hill and Garden Gully reefs have been cleared and blazed, and posts have been erected on them at every alternate intersection of the cross survey lines. They have been marked, as nearly as could be judged by surface observation, on the actual courses of the reefs. In following them, however, prospectors would do well not to confine their attention to the actual lines, but to test also any adjacent quartz outcrops on either side.

Besides the two lines of reef on which clearings have been made, there are many others shown on the plan which are worthy of careful trial, as they appear to be the sources from which the rich alluvial gold in the gullies was derived.

Many of the outcrops of the lodes have been superficially tested, but principally where the largest "blows" of quartz are visible. It is recommended that search be made by means of trenching, &c., for smaller veins on either side of such outcrops, as such veins frequently carry rich gold.

The well-known mode of occurrence of gold in distinct "shoots" at intervals along lines of reef, the intermediate portions being barren, should encourage prospectors to test any outcrop at a number of different points along its line.

The various alluvial workings, the proved extents of which are indicated with accuracy on the plan, will be found valuable guides in searching for auriferous reefs. Wherever runs of alluvial gold head from, or are known to have improved in richness after crossing particular lines of reef, such reefs should be exhaustively tested.

Attention is drawn to certain reefs shown on the plan which appear likely to reward investigation, as referred to hereunder.

1. A line of reef parallel with, and about 250 yards eastward from, the Garden Gully line; crossing Dead Horse Gully, and traceable to the 2¾-mile cross survey line.

From this reef much of the gold in Dead Horse Gully and some of its branches appears to have been derived; the workings in Gluepot Gully head from it; and a short run of alluvial gold starts from a place where the reef is crossed by a large gully immediately south of the 2½-mile cross line.

2. Several broken outcrops of quartz to the westward of Wellington Gully appear to indicate the reefs from which was derived the rich alluvial gold in the gully and in its western branch.

3. The line cleared along the supposed course of the Lightning Hill Reef intersects, between the 2¼-mile and 2½-mile cross survey lines, a gully which has been worked for gold up to the immediate vicinity of a conspicuous outcrop of quartz; this outcrop it would be well to test. Further northward on this line, and between the 2¾-mile and 3-mile cross lines, a narrow run of alluvial workings, heading from the line in a broad gully, also indicates the proximity of gold-bearing quartz.

4. A reference to the plan will show that to the eastward of the main survey line, between Opossum and Centipede gullies, a number of reef outcrops exist, near to many of which auriferous gullies take their rise. Careful search may be recommended here in spite of the non-success of former trials.

5. Many of the gullies not shown as gold-bearing on the map do not seem to have been thoroughly prospected. Further search for alluvial gold in these gullies would be advisable.

6. Concealed beneath the alluvial of some of the rich gullies there may be auriferous reefs unnoticed or neglected by the early diggers.

REGINALD A. F. MURRAY, Geologist.

Department of Mines, 10th June, 1880.

REPORT AS TO THE PROBABILITY OF AURIFEROUS LEADS BEING FOUND NEAR WANGARATTA, IN THE OVENS RIVER VALLEY.

Office of Mines,
Melbourne, 31st December, 1879.

SIR,

I have the honour to report that, in accordance with your instructions, I proceeded to Wangaratta on the 23rd inst., with a view to ascertaining the probable auriferous character of the district. The general wish of those interested appears to be that a line of bores be put down across the Ovens Valley in the neighbourhood of Wangaratta, to test the depth and character of the alluvial deposits.

Mr. Henry Tilt, Mr. Alexander Tone, J.P., Mr. Henry Kett, Mr. John Dodswarth, Mr. George Walker, and other gentlemen taking an active interest in the subject, courteously rendered every assistance to me in the examination of the country, and though that examination was brief, sufficient information was obtained, in addition to that already possessed, to enable me to submit the following remarks.

From the latitude of Oxley to that of Peechelba the average width of the alluvial deposits in the valley of the Ovens and King rivers is about 14 miles. The boundary ranges on either side consist of granite and schistose Silurian rocks. The alluvial deposits in the valley consist, as far as proved, of various layers of loam, clay, sand, and gravel—the detritus brought down from the southern and south-eastern ranges. The facts adduced in support of the belief that the deep alluvial deposits near Wangaratta are auriferous, are as follow :—

The heads of the Ovens River, and the hilly country generally along its eastern line of watershed, have proved highly auriferous from the Main Divide to Rutherglen, on which belt of country are the rich gold-workings of Bright, Stanley, Beechworth, Eldorado, and numerous others of more or less extent and richness. Among the western tributaries of the Ovens, the Buckland and the Buffalo rivers have yielded rich alluvial deposits, while workings of minor importance, but still remunerative, have been proved along the King River and some of its tributaries. It is argued that the enormous amount of detritus removed from the area of the Ovens watershed during the eroding action of past geological epochs must have necessarily been conveyed down the valley between Futter's range and Eldorado, and that consequently much gold must have been brought with it and deposited along some portion of the bed of the valley.

Abundant evidence was brought forward to prove to me that gold in fine particles and small quantity had been found in many places along the King and Ovens rivers, near Wangaratta, either in the gravels exposed along the banks, or in those reached in short depths by sinking. Near the King River, close to the Wangaratta Pound, numerous specks of fine gold were found in the gravel to a depth of 9 feet, beyond which the influx of water prevented further sinking. This, and several other instances of the discovery of fine gold close to or in Wangaratta, are vouched for by highly respectable residents.

Mr. Charles Chandler informed me that very fine scaly gold was obtainable in every dish of gravel from holes sunk to a depth of 40 feet, without bottoming, on his property, a few miles from Wangaratta, towards Eldorado. Mr. M. O'Neil stated that from four to twelve fine specks to the dish were obtained from gravel in a hole 6 feet deep, on his farm, near the Ovens River.

Mr. Wighton, in sinking a well on his property, between Wangaratta and Tarrawingee, found at 32 feet coarse quartz gravel, containing very fine gold and stream tin.

A speck of shotty gold, about 2 or 3 grains in weight, was shown to me as having been found in gravel at a depth of 3 feet on the farm of Mr. David McCormick, near Wangaratta, and Mrs. McCormick assured me that she was an eye-witness to its discovery.

The general geological character of the district, and the above statements, indicate, beyond a doubt, the existence of fine gold in small quantity in the upper gravels, and the probability that the heavier gravels on the bed-rock are richer in gold than the layers near the surface. It is pretty evident that the rock-bed of the valley, at whatever period it was eroded, was probably nearly bare during the earlier periods of its history, and was subsequently partly filled up again by the alluvial accumulations now forming a level plain between the boundary ranges. The deepest of these deposits—those lying on the bed-rock—were brought down by aqueous forces, probably of greater power than those of the present day, and along a bed more highly inclined than the existing surface. Taking into consideration the general fineness, as regards size, of the gold of the district, it is very likely that a considerable quantity was brought down; but, at the same time, it must be pointed out that the alluvial gold found so plentifully in the workings along the eastern ranges, was that which had been disintegrated from adjacent auriferous matrices by denuding influences, extending over incalculable periods of time, and had, nevertheless, been left behind while lighter materials were swept down the valley.

There are strong reasons for caution in estimating the workable value of deposits so remote from all proved auriferous matrices. It is impossible to say, without boring or sinking, whether the bed-rock of the valley consists of one wide trough, or of several channels separated by low ridges concealed by the present surface coverings. If the former be the case, the gold, even if in great aggregate quantity, is probably so scattered that it would not pay for the immensely heavy expenses of winning it; if the latter, the concentration of the gold within narrow runs or leads would render success more likely, but, at the same time, the expenses of working would be none the less heavy. At Eldorado, the nearest workings to Wangaratta, distant 10 miles therefrom, the yields were excellent, so far as the alluvial deposits were confined within narrow limits by the ranges on either side of the creek. The lowest workings on the creek, at its *embouchure* on the widespread deposits of the Ovens Valley, were, however, finally abandoned; not because gold ceased to be found, but because of its distribution over a wider surface of bed-rock, and the great expense of contending with the water. The latter difficulty would probably be greater in the main valley, where the subterranean drainage in such loose deposits as are known to exist must necessarily be very great. The arguments against the probable workable continuance of the Eldorado lead to Wangaratta, would apply with greater force to the similar extension of the more distant workings of Beechworth and elsewhere:—1st. The further from auriferous matrices, the less the supply of alluvial gold. 2nd. The wider the lead bed, the more scattered the gold. 3rd. The further down the valley, the greater the amount of water to be overcome, and probably the greater the depth of sinking. I have no hesitation in expressing an opinion that the deepest part of the alluvial deposits near Wangaratta cannot be much less than 400 feet, the depth at Eldorado on the lowest workings having been proved at nearly 300 feet. There are cases—as, for instance, the main lead from the Sebastopol plateau to the Durham, near Ballarat—where the depths of sinking from surface to gutter somewhat decrease as the main lead is followed down; but, in this case, the lead valley is partly filled in with volcanic layers, which become thinner as the valley is followed down, and, consequently, the seaward slope of the surface has for a certain distance a greater rate of incline than that of the subjacent lead bed.

As regards the remunerative character of the Ovens Valley deposits, there is one consideration which affords a slight ray of hope, and that is the possible existence of gold-bearing matrices in the subjacent bed-rock, which undoubtedly consists both of granite and schistose Silurian rocks. It is true that no shallow workings have yet been opened in Futter's ranges on the west, nor nearer than Eldorado on the east; but, beneath an alluvial tract having a course approximating to the general strike of the gold-bearing rocks, and a width of 14 miles, there is no doubt ample room for the existence of an auriferous belt equal to any yet proved, but there is unfortunately little evidence obtainable to justify very sanguine expectations.

Wangaratta is situated between, and nearest to the eastern of, two great belts of auriferous country having a north-westerly bearing, and distant about 50 miles from one another.

The eastern of these belts is that on which the Beechworth and Eldorado gold-fields are situated, and may be roughly described as adjacent to, and on the eastward of, a line drawn from the Crooked River, in Gippsland, to Rutherglen. The western belt may be similarly described as adjacent to, and on the westward of, a line drawn from Donnelly's Creek, in Gippsland, to Maindample.

The country along the Main Divide and southward into Gippsland, between these lines, consists principally of Devonian rocks (so far found nearly non-auriferous), which conceal from view the underlying schistose Silurian rocks, so that the character of the latter is unascertainable; in one place, however (Freestone Creek, in Gippsland), a rich but limited gold-field has been opened.

The mountainous country north from the Main Divide towards Wangaratta, though not properly geologically surveyed, is known to contain various rocks—granite, Silurian, and Devonian.

The gold-workings of the Buffalo and King rivers, and those near Benalla, show that auriferous matrices exist in the rocks between the two great belts above described, and therefore it is possible that such may occur in the rocks beneath the alluvial deposits of the Ovens Valley, but whether rich or poor cannot be ascertained except by actual exploration. After giving the subject the fullest and most careful consideration, it appears to me that the chances are against, rather than for, the probability of discovering workable auriferous deposits in the Ovens Valley, near Wangaratta. Boring would furnish good information as to the nature of the strata down to the bed-rock, the position of the deepest ground, &c., but would not be a reliable test as to the payable quality of any auriferous gravels intersected. Sinking shafts to complete the test would infallibly be a most difficult and expensive undertaking.

The best argument that can at present be advanced in favour of the suggested boring operations is, that if done with appliances which allow of the character of the strata passed through being examined, the information obtained will, at least, be of scientific value, even if no discovery of practical importance be the result.

Attention may be drawn to the northern portion of Futter's Ranges, where the geological formation is of a character warranting the belief that gold will be found in the gullies and quartz reefs.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

REPORT ON THE LOCALITIES WHERE GOLD HAS BEEN FOUND IN THE VICINITY OF BENALLA.

Office of Mines,
Melbourne, 6th January, 1880.

SIR,

I have the honour to report that on the 30th ultimo I visited Benalla, and, under the guidance of Mr. Edwin Brown, Shire Engineer, inspected the localities in the neighbourhood where gold has been found, consisting of a low range of Silurian rocks, about three miles south-westerly from Benalla.

At one quartz working the reef attains a thickness of 20 inches, and has been proved to contain gold, the last crushing of 5 tons having yielded 17 pennyweights of gold.

At another, known as the Lion Reef, two small veins about 1 inch in thickness have been followed to a depth of 230 feet, and it has been stated that they have yielded as much as 33 ounces of gold per ton, but their small size rendered them unprofitable to work.

In Whim Gully a shaft in alluvial was bottomed at 100 feet, and it is stated that yields equal to 8 pennyweights of gold per load from washdirt 3 feet in thickness were obtained during 70 feet of driving, but for some reason or other the drive was abandoned.

In another shaft further down the gully water was encountered, and, though gold was found, the deepest ground was not reached, and the final breaking down of the small engine used for baling water caused the abandonment of the undertaking. No working appears to be going on at present. The nature of the rock-formations, quartz reefs, &c., indicates a strong likelihood of payable gold existing in the vicinity. The shallow gullies have not been by any means properly tested, and this should be the first step in any prospecting operations that may be undertaken, as it would be of little use boring or sinking for gold in deep ground unless warranted by satisfactory discoveries in shallow gullies near the quartz reefs.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geologial Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

an underlay W. 23° S. at 71° in the "Evening Star" ground, being the most reliable observation obtained.

In this vicinity there are several other auriferous quartz veins; the want of a crushing machine close at hand, and the scarcity of water, have militated against the development of mining here, but work is in active progress.

Next, to the S.S.E., is the "Shepherd's" line of reef, having a bearing of from S. 25° to S. 30° E., and a very steep underlay to the W.S.W.; this reef yielded richly in former times, and a tunnel is now being driven to cut it at the deeper level. Several more or less parallel outcrops have been worked to the north of the Shepherd's line, and an exceedingly promising discovery has lately been made of a small but rich vein near what is known as the "South Shepherd's."

Near to the Reedy Creek township, on the north side of the anticlinal, the principal reefs are the Langridge, Crown, and Doyle's—all famous for the rich yields obtained from them.

That the Crown and Doyle's are one and the same line of reef has been proved by actual working, but difference of opinion exists as to whether it is or is not a continuation of the Langridge Reef; they are approximately parallel in bearing, about N. 25° to N. 30° W., with occasional more northerly deflexions and a W.S.W. underlay, but are not in the same line, thus suggesting that they are separate reefs; on the other hand, the occurrence of several slides and cross-courses in the Doyle's and Crown mines, justifies the idea, that the reef worked there may be simply the faulted continuation of the Langridge Reef. The direction of a slide found in the portion of the Crown workings nearest to the Langridge favours the latter belief; the continuation of the reef on the south-easterly side towards the Langridge has not yet been proved, so that it is unknown how far the slide may have faulted it; nor have the Langridge workings on the other side extended far enough northward to settle the question. The workings of the Sovereign Company in the narrow strip of ground between the Langridge and Doyle's lease blocks will no doubt throw some light on the subject, upon which some of the most experienced mining authorities on Reedy Creek have agreed to differ until actual exploration shall have proved which theory is correct. The leading features observed in the Langridge and Doyle's mines are that the general N.N.-westerly courses of the reefs intersect obliquely the W.N.-westerly strike of the strata, and that the reefs underlie W.S.-westerly, crossing the N.N.-easterly underlay of the strata. The course of the Langridge line of reef has been proved for some distance southward, and active steps are being taken to trace its further extension. The companies holding ground to the northward of Doyle's are also searching for the continuation of the Doyle's line of reef. The production, on a plan of the leases, of the general bearing of the reef (N. 25° to N. 30° W.) from the northernmost workings in Doyle's shows that a line bearing N. 25° W. crosses the S.W. angle of the North Doyle's lease area, and thence approximately along the line of the creek by the western boundary of the St. Ann's lease block. The N. 30° W. line crosses the S.W. angle of the North Doyle's, the N.E. angle of the Gladstone, and along the entire length of the North Langridge (Horne's) leased ground near its eastern boundary. In any case the Gladstone and North Langridge claims appear to be most favorably situated for getting the reef—if continuous—on its underlay, which would extend beneath the two leases from their eastern to their western boundaries, thus justifying the hope that these mines, if the reef be struck in them, may be of great permanence.

The unfavorable indications with respect to the continuance northward of Doyle's Reef are, that in the farthest workings in that direction the reef becomes somewhat disordered, apparently faulted, and a fresh make has not yet been found; on the other hand, similar disturbances have already been encountered and the reef picked up again. In addition to this, it appears that "specimen" gold has been obtained on either side of the creek, and in the alluvial workings along the boundary between the St. Ann's and North Langridge (Horne's) leases.

I am inclined therefore to the belief that, even if no actual continuation of Doyle's Reef itself be discovered, other makes and veins of auriferous stone will be found on its line of bearing.

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Westward from the Langridge, and on the other side of the anticlinal, is the "Saddle" Reef, bearing N.W. and S.-easterly obliquely across the strike of the strata and underlaying to the S.W. Work is being resumed on this reef, which appears to have been profitably wrought in former times.

The foregoing are the principal reefs in that portion of the belt extending on the S.W. side of Reedy Creek. On the N.E. side there are in the St. Ann's ground some partly explored veins in which gold has been found, besides a rather large quartz vein exposed on the bank of the creek near the south boundary of the lease. Further north-east is the Prince of Wales line, a "mullock" reef containing only a little quartz, but having well-defined walls bearing N.N.-westerly and S.S.-easterly with an underlay W.S.-westerly. The gold appears to occur in this line in shoots dipping northward and, from the easily worked character of the reef, and the thickness of mixed "mullock" and quartz which can be crushed, it has given good returns from a comparatively small yield (6dwt. to 14dwt.) of gold per ton. This reef has been traced S.S.-easterly into the adjoining lease, and its "track" has been found in the "Surprise" ground to the N.N.W. Other reefs have been proved in the Golden Crown lease and adjacent ground, all of which show the same features of a N.N.-westerly strike obliquely across the W.N.W. strike of the strata, and a W.S.-westerly underlay also crossing the N.N.-easterly underlay of the latter.

Proceeding further E.S.E. along the line of anticlinal, the next important reef is one, said to have been known as the Albert, on the north side of Thomson's Spur, and on the north side of the anticlinal. This reef appears to strike with the strata E. 25° S., and also to coincide with them in underlay N. 25° E. Operations are in progress to test this once profitably worked reef at a deeper level. On the south side of Thomson's Spur is the Morning Star Reef, on the south of the anticlinal also, striking with the strata E. 26° S., and underlying S. 26° W. This is a somewhat "mullocky" reef, that has been at one time extensively worked, and preparations are now in progress for its further development. Further north, on the divide between Reedy Creek and its tributary, Doctor's Gully, is the Red Rover line, and another parallel line a little north of it, worked by the United Gold Mining Company. Both of these have a N.N.-westerly strike, and a W.S.-westerly underlay, obliquely crossing the strata. Further eastward is the Empress line, a very true and small, but rich lode, coinciding with the strata, and lying between remarkably even and well defined walls—bearing W. 24° N.; underlay, N. 24° E. at 62°. This forms one of a group of reefs all close to the line of anticlinal, and of which the principal are the Queen Victoria, the Beaconsfield, the Captain's, the Kangaroo, and the Palmerston, all coinciding in strike with the strata. On the south side of the anticlinal, in the same vicinity, is the Russell's Reef, a small but rich vein, 2 to 4 inches thick, bearing N., 10° to 14° E., and underlaying E. 10° to 14° S., at about 52°. The strike of the strata is here W. 25° N., and the underlay S. 25° W. at 69°. About a quarter of a mile north of the Empress line is the President. Here there are two parallel veins coinciding in strike with the strata, W. 25° N.; one underlying with the strata, N. 25° E. at 51°; the other, the principal vein, underlaying in the opposite direction, S. 25° W., across them. Owing to influx of water from old workings, I was unable to see much of the two veins; but the manager informed me that they do not unite in a "cap," or apex, but thin out towards the surface, "pitching" downward in a W.N.W. direction on their line of strike. Besides those mentioned, there are many other exposures of quartz veins, some of which have been once worked, and any of which may be found to lead to profitable stone.

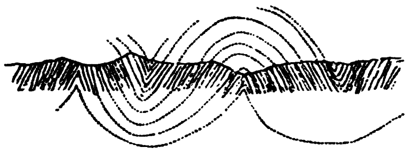
It may be generally remarked that the reefs rarely, if ever, exhibit a thickness exceeding 2 feet of quartz; from 3 inches to a foot is the general size, though in some cases portions of the "mullocky" casing can be profitably taken for crushing stuff.

The average yields, however, as is usually the case in Upper Silurian country, are very high, ranging from 1oz. to 10oz., and even more, of gold per ton.

It will be seen from the foregoing description that the various reefs within the survey, from the Kaiser at one end to the "Kangaroo" and "Palmerston" at the other, cannot be regarded as being merely different portions of one or two main lines of reef, but rather as so many distinct reefs along, and within a short distance on either side of, the axial line of anticlinal belt of strata, the reefs, however, differing more or less in their directions of strike and underlay, while the strata are remarkably well defined, and constant in both respects.

Most of the shoots of rich stone appear to dip northerly on their line of strike, and it has been noticed in some mines that, where a quartz reef has passsed some particular rock band, the richness of the stone has increased.

The observations made tend to support a theory on mineral veins generally, which was first advanced, I believe, by the eminent geologist, Von Bischoff, and which is here, as applied to quartz veins, submitted for corroboration or contradiction, as future experience may determine; it is, that the character of the quartz veins in a great measure depends on that of the strata which they intersect, even though those strata present no visible difference in appearance from other layers in which the quartz veins are not auriferous.



The undulations of the Upper Silurian strata are, as a rule, fewer and broader than those of the Lower Silurian : in the case of the one under notice at Reedy Creek, the N.N.-easterly and S.S.-westerly underlays are traceable for at least three-quarters of a mile on either side respectively of the line of upheaval; but there are certain to be, at greater or less distances, other parallel anticlinals, with synclinal or inverted "saddle formations" between. Knowing that the strata must have been originally deposited horizontally in the form of layers of sediment, and that these layers, acted on by whatever natural forces, have been folded in the form of a series of alternately anticlinal and synclinal undulations, it follows that, on leaving one anticlinal, and proceeding at right angles to its axis until the next is met with, we are likely to find in the latter a recurrence of the same layers as were met with in the first. Assuming that the composition of the rocks themselves is intimately connected with the auriferous character of the quartz veins intersecting them, there is fair ground for the expectation that, where certain set of layers, whose edges are exposed in an abraded synclinal or anticlinal fold, are found to contain auriferous quartz veins we may find similarly auriferous veins in the same strata, where the latter recur in the next fold. I am therefore inclined to the belief that belts of auriferous country, parallel to, and on either side of the Reedy Creek belt, will be found by careful prospecting. Reedy Creek itself has a course diagonally crossing the strike of the strata—the rich quartz-bearing belt under notice passes through what is known as the upper township; at the lower township, however, 3 miles down the creek, the alluvial diggings were very good, and I am informed that many "specimens" of gold in quartz were found, particularly in a gully known as Nuggety Gully. It is not likely that this alluvial gold and the specimens were derived from the quartz veins at the upper township, and there is good ground for the inference that near the lower township will be found a recurrence of the same strata as those at the upper, and that there is every probability of finding near the former locality a belt of quartz reefs running parallel with, and equal in richness to that proved at the latter. Similarly another belt may be looked for on the S.S.W. side.

Again, the bearing of the strike of the strata containing the auriferous reefs demands attention, for if, as before indicated, the character of the reefs has been influenced by that of the containing rocks, we may expect to find from point to point along such lines of strike fresh "makes" of auriferous stone. On the extension of the strike of the Reedy Creek anticlinal, small but rich reefs have been found in the ranges between the branches of Strath Creek, a tributary of the King Parrot Creek ; and even beyond that, on the same line, I am informed that gold has been found.

I am inclined to think, however, that, further to the south-eastward, the general bearing of the strike will deflect from its present somewhat unusual E.S.E. course, and assume a more southerly direction.

Mr. Selwyn's geological maps show a N.N.-easterly bearing of the Upper Silurian strata in the direction of Anderson's Creek, near Melbourne, and it may be that the rocks of the Anderson's Creek and Diamond Creek gold-field are the same as those of the Reedy Creek belt, whose line of strike would thus describe a curve deflecting from E.S.E. to S.S.W.

On the W.N.W. extension of the Reedy Creek belt nothing has been proved, so far as I am aware, beyond the divide between Reedy and Sunday creeks, a short distance from the "Kaiser" mine, but I found in the railway cutting at Broadford that the strata have the same E.S.E. and W.N.W. bearing with a N.N.E. underlay, while the bearing from the cutting towards the "Kaiser" is E. 35° S., or only a few degrees more to the S. of E. than the bearing of the strata. From this it may be judged that the prolongation of the Reedy Creek anticlinal will be found to trend from the Kaiser towards a point about a mile and a half on the Kilmore side of the Broadford railway station.

To the S.E. of the survey are the old Tonstall and Leviathan workings, on a great intrusive diorite dyke running in a north-easterly direction across the strike of the Silurian strata. This dyke has been traced from Sunday Creek across Reedy Creek to Strath Creek, and has been found to be intersected here and there by auriferous quartz veins, extending from wall to wall of the dyke. No work is being done at present, though some good yields of both gold and antimony were once obtained at various points. This dyke may prove worthy of further attention, especially where it crosses the lines of any known auriferous belts of Silurian strata.

Before concluding, I beg to offer a few remarks, which have been suggested by observations made in the Reedy Creek and other districts.

The Upper Silurian rocks, being generally less fissile than the Lower Silurian, are liable to be intersected more irregularly by vein fissures than the latter. Though the nature of the forces which caused such fissures, and the mode of deposit of the quartz in them, be imperfectly understood, it is evident that the direction in which such forces acted, would influence the direction of the fissures so far, that, though having a natural tendency to split along the planes of stratification, the strata would become in places fractured and fissured in planes crossing both their strike and their underlay.

Where such was the case the continuance of fissures for an indefinite distance in the same directions could not well be expected, and hence there is a liability on the part of such quartz veins as those of Reedy Creek to run out or become disordered, and split up as followed longitudinally, independent of such slides or other dislocations as have occurred *since* the lodes were formed. On the other hand, there is no cause to doubt the continuance of the vein fissures downward, and for this reason deep mining at Reedy Creek seems likely to prove as successful as in any other part of the colony. So that, once a rich "shoot" of quartz is found, no pains should be spared to trace its downward continuation.

If the theory that the character of the veins has been influenced by that of the containing strata be correct, the auriferous quality of veins intersecting both the strike and underlay of the strata, may be expected to vary, as the veins pass through different sets of layers; so that, even if an auriferous "make" of stone were to become impoverished or attenuated at a certain depth, there is a fair chance of its being found to regain its good qualities when traced still further down into other strata. This is a matter on which miners would do well to take careful observations, as by so doing they may in many cases be enabled to regain the run of the gold after its apparent cessation in some portion of a mine; in this respect each separate mine would require special study. Another subject on which it appears desirable to say a few words is the theory, entertained by many, that such small quartz veins as those of Reedy Creek are likely to make into larger bodies, and that the veins proved so far are but the twigs and branches of large trunk lodes of quartz situated at considerable depths. Now, there is no reason why large quartz lodes should not exist at depths even where, as at Reedy Creek, only small ones appear at the surface, but the belief that such may be the case is, in the minds of many, founded on another hypothesis, namely, that the quartz was injected in a molten or plastic state into the vein fissures, and that consequently there must be main bodies of quartz from which the smaller veins branch forth. This latter hypothesis may be said to be now entirely disproved; the general evidence is now in favour of the theory that quartz and its associated metallic ores were segregated from the surrounding rock "country" by the action of permeating mineral waters, probably aided by heated waters, steam, and vapours from below. It would, in this case, follow that the existence or otherwise of large subterranean bodies of quartz would depend altogether upon whether large subterranean fissures existed in which such quartz could be deposited, and that though, as is frequently the case, a net-work of fissures branching from one main line of fracture has allowed of the formation of a main lode and a number of tributary leaders, there is no reason to suppose that even such small fissures as contain the Reedy Creek veins, may not continue downward as far as the Silurian rocks extend without increasing in size or trending into larger lodes.

As a final suggestion, I would beg to call attention to the importance—especially at Reedy Creek, where yields may be vacillating—of taking advantage of prosperous seasons during the working of good "shoots" of stone, to lay by substantial reserve funds for the future dead work of tracing such "shoots" further downward; or, better still, to have that exploring work in active progress, and well in advance of such portions of the lodes as may be yielding good returns. Large dividends are no doubt pleasant to the recipients, but the share value of the mines would be steadier, and their prospects of permanence better, were it known that, by a slight curtailment of dividends, adequate provision was being made to eliminate the more objectionable feature of calls from the future operations of a mining company.

In conclusion, I beg to acknowledge with thanks the information afforded, and the uniform courtesy shown by mine managers and miners generally with whom I came in contact during the progress of the survey.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

REPORT OF THE EXAMINATION OF THE COUNTRY AROUND GEMBROOK.

SIR, Talbot, 8th February, 1882.

I have the honour to report that, in accordance with your instructions, I made an examination of the country around Gembrook, with a view to ascertaining the probability or otherwise of coal being discovered there.

I may state that previously, I was well acquainted with the geology of the country surrounding Gembrook, on and adjacent to the following lines, viz.:—From Berwick by the Dandenong Ranges to Lilydale; from Lilydale to Hoddle's Creek; from Hoddle's Creek to Buneep; and from Buneep to Berwick.

Although able to pronounce with absolute certainty on the impossibility of discovering coal along the circumference above indicated, I was unacquainted with the central portion of the tract of country within that circumference, and it was deemed advisable to examine it on the chance of there being an isolated area occupied by carbonaceous rocks.

My inspection, however, confirmed the belief already entertained, that such rocks do not exist there.

The prevailing bed-rocks, exposed in the creeks, and on most of the ranges, from Berwick *viâ* Gembrook to Lilydale, are granite and Upper Silurian rocks.

At Gembrook there is an area of decomposed volcanic rock which overlies Middle Tertiary deposits, filling ancient channels and hollows in the Upper Silurian

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rocks. The existing watercourses have, in some cases, cut their way down into the bed-rock to a deeper level than the old channels, which latter lie beneath what are now spurs and ranges, consisting at the surface of decomposed older volcanic rock.

Among the Middle Tertiary deposits lying between the older volcanic and the Silurian or granite bed-rock are layers of lignite, pieces of which have been found on the hill slopes, and have been mistaken by the residents for coal, or indications thereof. Beyond the fact of their existence as proved by the pieces found, nothing is known of the extent or thickness of these lignite seams.

The geology of the country is precisely analogous to that of the Crossover and Russell's Creek districts in Gippsland, described in Progress Reports Nos. III. and VI.

I can state with perfect confidence that there is no chance whatever of coal being obtained in the district, and it would be useless expenditure to bore in search of it.

With respect to the lignite, it may be worth while on the part of land-owners in the locality to test the thickness and quality of the seams by sinking holes on the hill slopes, slightly above the highest points at which pieces of lignite are found most plentifully in the surface soil. The few small pieces shown to me were of good quality, and resembled the Crossover lignite, which is reported to yield 6,000 feet of gas per ton, and would be of commercial value were the facilities for transit greater.

I may also point out that there is a fair probability of payably auriferous gravels being found resting in places on the Lower Silurian bed-rock underneath the older volcanic and lignite layers. As some of these would be above the levels of the deeper creeks and gullies, they should be prospected for by means of shallow holes sunk along the hill slopes near the lower edges of the volcanic rock, and where it extends furthest down the slopes. Once discovered, the gravels could be further explored, and worked, if found auriferous, by means of tunnels where practicable, and by means of shafts where they are found to occur at a lower level than existing watercourses.

While regretting that I am unable to recommend the views of the deputation with respect to coal prospecting, I have great pleasure in indicating the possible existence in the Gembrook district of other sources of mineral wealth in the shape of auriferous deposits.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

REPORTS ON A PORTION OF THE PLATEAU SITUATE BETWEEN THE THOMSON AND THE TYERS RIVERS, GIPPSLAND.

SIR, Talbot, 15th March, 1883.

In reply to your memorandum on correspondence L.83/2845 of the 5th inst., I have the honour to report that basalt constitutes the surface formation of a considerable portion of the plateau between the Thomson and the Tyers rivers, westward of the Walhalla copper mine.

On the published geological sketch-map of South-Western Gippsland, prepared by me eight years ago, only a small portion of this basaltic area is indicated—between Jacob's Creek and the Tyers.

Since the publication of that map I have had further opportunities for examination, and have found the longitudinal or northerly and southerly extent of the basalt to be greater than represented on the map.

During the sketch-survey of a block of country to the north—embracing the heads of the Glengarry, Tangil, Tyers, Thomson, Yarra, and Goulburn rivers—commenced six years ago, but still uncompleted, owing to pressure of other work, I found that the basalt extends some miles north-easterly from Jacob's Creek, and breaks off on the fall towards the Thomson, its north-easterly or up-stream continuation having been evidently removed during the erosion of that river. At Mount Look-Out, and other places between the Thomson and Aberfeldy rivers, are patches of basalt, apparently the vestiges of the denuded upper portion of a long and continuous lava-flow which filled an ancient valley corresponding approximately to that of the Thomson, but not eroded to so great a depth in the Silurian rocks as the latter.

The basaltic area under notice extends through portion of Moondarra and between Jacob's Creek and the Tyers, and undoubtedly covers an unremoved portion of the ancient channel several miles in length. It is in every respect similar to the basaltic plateaux described in the report on the Russell's Creek gold-field, and I have seen at its edges deposits of coarse gravel and cement evidently passing under the basalt, though, to all appearance, not those of the deepest portion of the old watercourse.

I believe that, with a small amount of well-directed labour, the inlet of the lead on the north-eastern slope towards the Thomson could be found and tested. If proved payably auriferous there, the tracing out of the lead southward would follow as a matter of course.

As to the southerly extension, it would be impossible to say without further examination whether it passes the heads of Rintoul's Creek and so down to the basalt in the low country near Eaglehawk, or whether it has been denuded from the country now traversed by the lower portion of the Tyers Valley. A week's inspection would enable me to determine this.

Though no discoveries of importance have yet been made to my knowledge, I understand that gold has been found in the exposed gravels above mentioned.

The geological indications are certainly favorable to the belief that payable gold may be found in the deeper portion of the lead. All depends upon whether the Silurian rock, disintegrated during its erosion, was traversed by auriferous quartz-veins.

Experiment alone can determine this, and such experiment is fully warranted by the geological conditions.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

SIR, Warden's Office, Sale, 13th April, 1883.

In compliance with the desire expressed by the Honorable the Minister of Mines that I should report upon the locality referred to in the annexed correspondence, I have now the honour to state that I have only a personal knowledge of that part of the plateau which is near to the Cooper's Creek copper mine, and am therefore not in a position to speak of the whole area without a special examination. With regard to the part to which I have referred, I am of opinion that it is well worthy of being prospected for gold, and I may add, from a general knowledge of the district, that on perusal of Mr. Murray's report, I entirely concur in the statements and the recommendations made by that gentleman. If it is desired that I should make a more detailed report, I will make arrangements to visit the locality specially.

I have the honour to be, Sir,
Your most obedient servant,
A. W. HOWITT,
Warden.

Major Couchman,
Secretary for Mines, Melbourne.

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GEOLOGICAL SURVEYOR'S REPORT ON THE DEEP LEADS OF THE LODDON VALLEY.

The total area represented by the published geological maps of Creswick, Glengower, and Moolort, by those of Learmonth, Clunes, and Mount Greenock, in course of publication, and by that of Rodborough, now under survey, contains the most important portion of the great group of deep-lead systems lying between the parallels of Creswick and Laanecoorie.

The national interest attached to the successful development of these deep leads renders it advisable to lay before the public the broad deductions as to probable future prospects arising out of the scientific examinations made. Before doing so, and in order to elucidate the reasoning, it is necessary to briefly state the main facts of geological history, notwithstanding that they have long been recognised, and are probably by this time patent to nearly all engaged on, or interested in, the alluvial mines of the district.

First, we see that the Lower Silurian bed-rock, during the interval extending from the Middle Palæozoic to the Post-Tertiary periods, has undergone an amount of denudation which has worn it down many thousands of feet below its original surface.

Geological evidence in other districts shows that the folding of the once horizontal Silurian strata into their present highly inclined or vertical positions, and the formation of some, if not all, of the auriferous quartz veins in their fissures, must have taken place at all events before the close of the Upper Palæozoic epoch. There are now in the district under notice no remnants of formations intermediate between the Lower Palæozoic Silurian rocks and the Middle Tertiary deposits.

Such intermediate formations may have once existed, and have since been swept away, or the periods during which they were elsewhere deposited may have been here solely occupied by the work of denudation, but the broad fact remains, that during the whole range of the Upper Palæozoic, Mesozoic, and Lower Tertiary epochs, denudation of the Silurian bed-rock was in progress; that deposit after deposit of the detritus so worn from the bed-rock was formed, and that these in their turn were denuded and re-distributed, until in the Upper Tertiary deposits of the leads and reef-washes was arranged the concentrated residue from the degradation, during incalculable ages, of hundreds of cubic miles of Silurian rock, and of the quartz veins contained therein.

Whatever were the forms of denuding action that operated during these ages—and they were probably various—fluviatile, or river action, appears to have been the latest. Marine and glacial action no doubt eroded the first outlines of the Loddon Valley. During the many successive emergences and submergences above and below the sea to which this land has been subjected, different forms of denuding action operating in different directions and methods have, from time to time, come into play, and, at the commencement of the Tertiary era, the main outlines of the present Loddon drainage area and of the principal lead channels had already been rudely sculptured, and much of the detrital matter, including gold, now composing the Tertiary gravels, had already been disintegrated from the Silurian rocks. The Upper Tertiary period, during which the lead-channels were deepened, and previously accumulated detritus, added to newly eroded materials, were concentrated and sluiced down in their beds, was, in this district, one of terrestrial and fluviatile conditions. The fossil wood and fruits found in both the Ballarat and the Creswick leads, the ancient surface soil that is here and there met with, and the arrangement of the materials in the lead-beds, all indicate that immediately prior to the Upper Tertiary lava-flows there existed, within the present water-shed of the Loddon, a system, or group of systems, of well-defined rivers and streams, having gravel and boulder deposits in their beds and on their banks, and separated by ranges and ridges more or less overlaid by gravels and other deposits of former periods that remained unremoved, or by surface angular deposits and soil, such as we now see partly covering or flanking exposed Silurian ranges.

The principal boundary ranges and leading spurs such as were not soon afterwards covered by lava-flows were higher, bolder, and less broken by gullies than at present, for there is ample evidence of the exposed Silurian areas having been greatly reduced in vertical height since the lava-flows. There are also fair grounds for the assumption that, owing to the greater height of the mountain system, the rivers of the period were better supplied with water and far more powerful than the existing streams, even if glaciers did not occupy the higher ravines.

This ancient river system, in its main outlines, corresponded very closely with that of the present Loddon River and its principal tributaries.

The volcanic activity which closed the Tertiary era in this country was strongly developed in the district under notice, as evidenced by the number of unmistakable points of eruption, such as Spring Hill, Moorookyle, Horseshoe Hill, and a host of others, which form such prominent features of the country between Creswick and Carisbrook.

The result of this action was the filling up of the old valleys, leaving only the higher boundary ranges and portions of the leading spurs between the larger channels standing above the surface of the lava-flows. In some places even the lower "saddles" of the former were covered, as in the case of the country south-west from Creswick, where the volcanic rocks completely cover the ancient main divide between the leads trending southward towards Ballarat on one side, and northward towards Clunes on the other.

As to the number of different eruptions, and the extent of the respective lava-flows from each of the numerous volcanic cones, the overlapping and blending with one another of the different lava streams, it is difficult to conjecture. As many as four distinct "rocks," or basaltic layers, separated by alluvial deposits indicating periods of comparative tranquility, have been proved in the course of mining operations, and it is not certain but that each of these may consist of several closely successive lava-flows. The general result of the eruptions was that the volcanic material from the different vents filled the main valleys from side to side, covering the deeper channels to a depth of as much as 400 feet. This volcanic period, though of short duration from a geological point of view, probably covered a great actual lapse of time, during which important modifications were effected by denudation acting on the exposed Silurian country. Since the cessation of volcanic action, the existing main drainage channels have been formed by Post Tertiary and recent action, in some places along the margins, of, in others across, the areas occupied by the basalt, while further degradation in vertical altitude and the erosion of a complicated system of creeks and gullies has been effected in the rangy Silurian country.

Great as was the extent to which the lava-flows filled up the old channels, it was not sufficient to materially alter the general positions and directions of the main lines of drainage, except, perhaps, south-westerly from Creswick, where the present main divide appears to be somewhat further south than the ancient one, but of this there can be no certainty until proved by mining operations.

With this possible exception, and a few local deviations, all the present main and tributary channels of the Loddon Valley take the same general courses, and drain the same areas, as did the corresponding streams prior to the lava-flows, and it is a matter of absolute certainty that all the lead systems within the Loddon watershed, from east, west, and south, trend to form two main trunk leads lying between the same boundary ranges as the present valley of the Loddon. The junctions of the different leads with one another, with the two trunk leads, and of these with one another, will probably be found to conform very nearly to those of the present principal corresponding creeks with one another, with the Loddon, and the Deep Creek, and of the two latter respectively.

In treating of the leads, I propose dividing the subject into two heads :—1st. Their positions and courses. 2nd. Their probable auriferous character beyond where they have yet been explored.

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1.—Positions and Courses of Leads.

With regard to the courses of leads, it can be seen that near their heads, where split up into a number of branches, and those branches separated by well-defined prominent spurs, the lava-streams which filled them were confined within comparatively narrow limits, and the courses of the subsequently formed drainage channels have approximated very closely to those of the ancient ones; but further north, where the different groups of small leads unite and become large ones, and the dividing Silurian ridges are of less altitude, the latter have in most cases been covered by the lava, and though, as before remarked, the general trend of the drainage remains unaltered, the present creeks frequently make considerable local deviations from the ancient lines of watercourse.

Recognising, as they do, the general geological principles of the subject, many of the leading miners of the Smeaton and surrounding district incline to the proposition that, within that volcanic area, each separate creek and its tributaries represent a corresponding lead, its branches holding similar positions and courses beneath the basalt. To a great extent this belief is perfectly correct, and is substantiated by facts, but caution is requisite in extending it beyond generalities to matters of detail.

It is certain that there are leads corresponding respectively to Coghill's Creek, Creswick Creek, Bullarook (Birche's) Creek (all of which meet and form the Deep or Tullaroop Creek), also to Middle Creek, Joyce's Creek, and the Loddon River; but before taking for granted that the leads will be found to conform even to the general windings of these creeks, it is necessary to regard the physical effects produced by the volcanic outpourings. When we consider that in this district a number of volcanic cones established themselves along the course, and from side to side of, the main depression through which the leads took their courses, it is not difficult to realize that these points of eruption might have made their appearance either in the actual beds of the leads or on the slopes or summits of spurs dividing the leads from one another. It is evident, however, that within the entire area over which these eruptions took place, the area of actual lead-bed was less than that occupied by intervening slopes and spurs, just as at the present day, the area of the actual creek and gully beds is less than that of the ridges and slopes between them; so that, reducing the matter to a question of probabilities, the chances of the volcanoes bursting forth in the beds of the leads, or on the slopes and summits of the hills, would be to one another as the areas respectively occupied by each, and the probability would consequently be in favour of the latter, which occupied the larger extent. The less resistance to subterranean forces in the deeply eroded lead-beds, might be imagined to incline the probabilities in favour of the eruptions taking place there; but, on the whole, it does not appear that the differences in degree of resistance, resulting from the comparatively insignificant differences of altitude, were sufficient to materially influence the positions at which the volcanoes established themselves.

A volcano elevating its cone in the bed of a channel, and pouring its lava-streams along that channel, would inevitably cause the succeeding watercourse to form on one side or other at a greater or less distance, according to circumstances, from the ancient one, but still within the same boundary ranges, provided they also were not overspread by the sheet of lava which covered the lead.

On the other hand, volcanic cones established on the ridges or slopes between the leads would elevate those ridges by means of the added material contemporaneously with the filling of the leads; the most depressed portions of the newly formed surface would still lie immediately or nearly so over the obliterated channels, and the new watercourses would consequently conform closely to the positions of the old.

In places where, as in the Smeaton district, a group of volcanoes burst into existence across the whole width of a main valley traversed by a number of different channels, the blending and overlapping of the different lava-flows from the several points would in many places cause important local deviations from the original courses in the channels formed subsequently. The places where such influences appear to have taken effect or to render the positions of the leads doubtful, will be referred to in the forthcoming remarks on the lead systems themselves.

Under the title of the leads of the Loddon Valley, I refer most particularly to those of that portion represented by the geological maps mentioned at the commencement of this paper, lying within the drainage area of the Deep Creek, Joyce's Creek, and their numerous tributaries, and extending as far north as Laancoorie, about which parallel a junction most likely takes place of two great trunk leads, that of the Loddon itself and Joyce's Creek on the east, and that of the Deep Creek and Bet Bet systems on the west. As a number of geological maps have been published showing the country traversed by the Loddon and its branches from the junction of Joyce's Creek upward, it is sufficient to say that beneath that portion of the Loddon Valley extending between Newstead and Joyce's Creek, must necessarily lie the trunk lead formed by the combination of all the leads of the whole eastern section of the Loddon drainage area. Comparatively few of these leads are covered by basalt, and consequently they were early discovered and worked, but a considerable portion of the main trunk lead remains unexplored, especially near Newstead, and thence north-westward. A branch lead covered by basalt, and corresponding to Green Gully, joins the main one at Newstead ; this does not appear to have been tested. The volcanic plain between Joyce's Creek and Moolort railway stations evidently covers a lead coming from the south, probably corresponding to, and lying a short distance westward of and parallel with Joyce's Creek, and joining the main lead from Newstead beneath the plain north of the railway line between the two stations referred to. This combination makes up the great eastern trunk lead of the Loddon Valley, and appears likely to join the western one near Laanecoorie.

Of the known leads of the western section of the Loddon drainage area, or that traversed by the Deep Creek and its tributaries, the principal in point of size is the Rocky lead, which corresponds to the Bullarook or Birche's Creek. This has been worked from near Daylesford down to within a short distance of Bullarook, and will no doubt soon be traced further. The geological indications, as well as information obtained by means of boring, show that the course of the lead is adjacent to that of the Bullarook Creek, at any rate as far as the township of Smeaton. Considered simply as an ancient river, this lead is certainly the main head branch of the old lead system, just as its modern equivalent, the Bullarook Creek, is the main head branch of the present drainage system. Important, in a mining sense, as are the leads heading from Spring Hill and contained within the Loughlin, Ristori, Madame Berry, and other mining properties, they are, when regarded in the light of rivers, only tributaries to the Rocky lead in the same proportion as the surface watercourses heading from Spring Hill and running northward have to the Bullarook Creek. The junction of the leads running northward from Spring Hill with the Rocky lead seems likely to be somewhere about the Bullarook Creek, north of the Madame Berry property. As to the exact course of these combined leads (termed the Eastern system in my former report—Progress Report No. VI.), there is little evidence to justify a decided opinion, but the general trend cannot fail to be in the direction of Horseshoe Hill, or westward thereof. Experiment alone can trace out the actual windings.

The Australasian lead is the ancient representative of Creswick's Creek, but owing to the presence of the volcanic cones of Cattle Station Hill, and another point eastward, the present creek has taken a course westward of the lead. Whether the Australasian lead runs directly north to join the Rocky and Madame Berry group, or winds round the north of Cattle Station Hill to join the Clunes group, is uncertain. The positions of certain outcrops of Silurian rock favour the former view, while the direction of the present surface drainage indicates the latter as probable.

The Clunes group of leads, or that referred to in my previous report (Progress Report VI.) as the "western lead system," must be a very important one as regards size, though only one branch (the Lothair lead, at Clunes, and some tributaries near Creswick) have been worked. This system corresponds to Coghill's and the lower portion of Creswick's creeks, and cannot fail to form into a very large main lead north-eastward of Clunes, between that town and McDonald's Hill, whence its course will certainly be found to approximate very nearly to that of the Deep Creek, as far as Horseshoe Hill. The exact locality where the junction of the western, or Clunes system, and the eastern, or Rocky lead system, takes place, is doubtful; the junction of the present creeks cannot be taken as an indication because the chain of volcanic cones formed by McDonald's Hill and other hills to the eastward across the valley have caused the Bullarook Creek to sweep considerably to the west, and it remains a matter of conjecture whether the eastern or Rocky lead system conforms to the present creek, and joins the western system between Clunes and McDonald's Hill, or whether the former trends past the eastward of McDonald's Hill, and effects a junction with the latter further north towards Horseshoe Hill. The information afforded by a deep bore in the Lord Clyde Company's property favours the latter view.

In addition to those already pointed out, there yet remains the alternative possibility that the Berry group trend westerly to join the Clunes group between Clunes and McDonald's Hill; that the Rocky lead maintains an independent course until after passing the deep bore in the Lord Clyde ground, and that the junction of the Rocky on the one hand, and the combined Berrry and Clunes leads on the other, takes place beneath, or near the Deep Creek at Horseshoe Hill.

A lead is likely to exist beneath the basalt between Clunes and a low Silurian range a mile to the weswtard. Between that range and Mount Beckworth is another lead, whose course is marked by a well-defined strip of basalt. Rising to the west of, and skirting round the north of the Mount Beckworth range, is another similarly well-marked lead.

All these three leads come together between Clunes and the Eglinton swamps, and the lead formed by their combination joins the main system about the Deep Creek eastward of the swamps.

It can be seen, in the case of the two leads from Mount Beckworth, that the lava-flows have caused a deviation of the drainage, for the waters from Mount Beckworth now run into McCallum's Creek, whereas, before the lava-flows they took the course indicated by the trend of the leads towards the ancient equivalent of the Deep Creek. Another western tributary lead heads from Mount Glasgow, runs easterly towards Mount Cameron, and joins the main system abreast or northward of Horseshoe Hill.

The Hepburn lead system northward of Smeaton pretty clearly corresponds with, and takes nearly the same course as the Middle Creek as far as Glengower township, whence the creek trends away to join Joyce's Creek, but the lead appears likely to join the combined Clunes and Rocky lead systems. This belief is supported by the existence of a number of Silurian outcrops between Middle and Joyce's creeks, which appear to be exposed points of a partially covered range forming the north-eastern confine of the lead system. There is unmistakable evidence that the whole of the above-described Clunes, Rocky, and Hepburn lead systems, and whatever concealed tributaries may run into them, will be found to unite in one great lead in the vicinity of the Deep Creek, a short distance west or north from Horseshoe Hill, or between the exposed Silurian outcrop at which is the Clarke's Quartz Company's mine, near Glengower township, and the exposure of bed-rock in the Deep Creek, 3 miles to the north-west.*

Between the small outcrop at Clarke's and the larger Silurian area at Cambelltown, there is certain to be a minor lead system; but there is so far nothing to show whether it trends to join the Deep Creek system northerly from Clarke's, or turns north-easterly to join that previously indicated as corresponding with Joyce's Creek.

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* The position of the further extension of this trunk lead has since been ascertained by means of the bores put down by the Bucknall's Estate Gold Mining Company, to be in the vicinity of the Middle Creek, near Mr. F. Bucknall's Homestead.

Near Majorca, the Mount Greenock, Talbot, and Majorca lead system, corresponding to McCallum's Creek and its tributaries, debouches on the Deep Creek Valley, and will probably be found to join the trunk lead of the latter in the vicinity of Moolort Hill.

Between the exposed Silurian rock near Carisbrook and that on the Loddon, there is a wide extent of basaltic country, divided for some distance into two broad strips by a long, low, isolated rise of exposed Silurian rock, extending for 3 miles north from the Moolort Railway Station. Under the eastern of these two strips will be found the great trunk lead, corresponding to the Loddon itself, with the Joyce's Creek system added; under the western lies the trunk lead formed by the combination of the Deep Creek systems. The two probably unite about Laanecoorie, and continue as one great lead, which receives further tributaries as it goes northward. The Bet Bet system appears likely to join that of the Deep Creek just above Eddington.

How far the trunk lead will be found to preserve its fluviatile aspect is uncertain, but it appears likely to do so as far as the latitude of Inglewood. Beyond there, the fluviatile deposits of the leads may be expected to be found to blend with the marine deposits of the ancient sea into which the former rivers flowed, or else to spread over the marine beds of Middle Tertiary age which underlie the plains of the Murray Valley.

2. PROBABLE AURIFEROUS CHARACTER OF THE LEADS BEYOND WHERE PROVED.

In considering the probable auriferous quality of the unexplored portions of the above described leads, the following main propositions, now recognised and accepted by all intelligent miners, form the basis of the reasoning, in conjunction with other observable phenomena not so widely recognised, which will be here brought under notice. The propositions referred to are:—1st. That all "alluvial" or detrital gold—in Victoria, at all events—has been derived from the degradation of auriferous quartz veins traversing the Silurian rocks. 2nd. That no free detrital gold has ever been transported very far after being so disintegrated from its matrix. The truth of the first is so evident as to need no comment. The second admits of a certain amount of modification, according to the circumstances of each case it may be applied to. A fragment of free gold, having from seven to nine times greater specific gravity than most of the other substances with which it is associated, would naturally oppose proportionately greater resistance, bulk for bulk, to any transporting agency brought to bear upon it; its greater weight, too, would cause it to sink more readily, and so more easily escape removal.

Even when the supporting material is removed from around and beneath a piece of free gold, its tendency is simply to drop and remain in the first crevice, or "catch," that presents itself. It is easy to conceive, however, that such a fragment might, during long ages of denudation, be transported for a considerable distance from where it was separated from the matrix, especially when the surface altitude has been greatly lowered by such denudation. For instance, supposing a piece of gold to become detached from its matrix at an elevation of 2,000 feet above the sea-level, and the surface to be subsequently reduced by denudation to an elevation of 1,000 feet; the gold in dropping vertically, as the surface became lowered, would also be moved horizontally in the direction taken by the operating forces, to a greater or less distance, according to the strength and nature of those forces, the degree of incline, and the nature of whatever substance it from time to time rested on. At the same time, while such gold was being moved one mile, millions of tons of Silurian rock would be disintegrated and removed as silt, sand, or gravel for scores of miles. Gold, either free or attached, would also be liable to removal for considerable distances from hill-slopes into valleys by land-slips, and a glacier would slowly but surely move along a large nugget as easily as a fragment of rock.

Notwithstanding, however, all possible conditions under which gold might be moved from the locality of its former matrix, experience has conclusively shown the general truth of the second proposition given above, and of the consequent deduction that alluvial gold in payable quantity and of appreciable size is only to be found in leads or other detrital deposits adjacent to where the Silurian rocks now contain, or their denuded upper portions once did contain, auriferous quartz veins. There is good reason for believing that, in the thousands of feet in the vertical height of Silurian rock that have been worn down by various forms of geological action since the Upper Palæozoic epoch, the contained auriferous quartz reefs were richer, and the gold in them occurred in larger masses than is the case with outcropping reefs at the present surface, in the same proportion as the latter are on an average superior in richness and the size of their contained gold to their downward continuations at considerable depths.

In estimating the probable quality of a lead at any given locality, it is necessary to know the position of that place with respect to known gold-producing and non-productive shallow tracts respectively. On this subject we now have copious data, for there is hardly a gully in unalienated land within the Loddon watershed but has been more or less tested, and any map now prepared showing the actually worked and unworked areas of shallow ground, would, with tolerable accuracy and completeness, represent thereby the really auriferous and non-auriferous areas respectively.

The mode of distribution of gold, whether in quartz or in detrital deposits, indicates very clearly that only in certain groups of Silurian rock-bands do the quartz veins contain gold in appreciable quantity, and that only on or close to such groups do the alluvial deposits, whether deep or shallow, contain payable gold.

The normal strike of the highly inclined and sometimes vertical Silurian rocks is in this district nearly meridional, or from N. to N.N.W. magnetic, and if an observer take a map showing the different gold-fields west of the meridian of Castlemaine, and notes their respective positions, he will not fail to be impressed by the fact that they lie in approximately parallel belts, having that meridional direction.

Beginning at the eastern side of that part of the Loddon Valley immediately under notice, the first of these belts that has any immediate connexion with it is that of which Maldon is the northernmost, and Morrison's diggings, on the Moorabool, the southernmost. A line drawn on the map between the two places has a bearing of about N. 12° W., and passes directly through Egerton and Gordon, forming the western margin of a belt about 4 miles wide, within which are situated, in addition to those just mentioned, the gold-fields of Steiglitz, Daylesford, Jim Crow and Yandoit creeks, and a number of intermediate workings of less note.

The portion of the Loddon Valley deep lead, near and below Newstead, is just below the course of this belt, and the lead should on that account be rich, unless some break in the auriferous character of the belt occurs there.

Next to the westward is the Elaine and Mount Doran belt, whereof the N. by W. extension would pass Bullarook and near Smeaton Hill, beyond which the shallow workings east of Cambelltown are about upon its course. It is noticeable also that the Hepburn Home Paddock lead heads from about this zone, the further production of which beyond Cambelltown would bear for the junction of Joyce's Creek with the Loddon, thus affording a favorable indication as to the value of the deep trunk lead there. Gold has been found in the shallow ground on the course of this belt between Cambelltown and Joyce's Creek, but the land, being alienated, has not been thoroughly tested; it is likely that good shallow workings may yet be found in this locality, and that leads in the beds of the larger tributaries on the east will be found to pass under the creek to join the leads beneath the basalt to the west of it.

The next auriferous belt is the most important in the colony—perhaps in the world. Within parallels about 5 miles apart, and extending N. by W. for a distance of 80 miles, are situated the gold-fields of Durham, Buninyong, Sebastopol, Ballarat, Creswick, and Kingston to the south of the basaltic plains of the Loddon Valley, and forming so far an unbroken gold-bearing belt 30 miles in length. To the north of Eddington, on the production of the belt north of the plains to shallow ground, are Kay's Diggings, Tarnagulla, and Inglewood.

On the next belt to the westward are the gold-fields of Clunes, Majorca, Carisbrook, and Jones' Creek, besides intermediate workings. For a considerable length on the course of this belt, the Silurian rocks are covered by Tertiary accumulations and basalt.

The last group of auriferous belts to be here referred to is perhaps next in importance to the Ballarat belt, and includes within a total length of 100 miles by a width of 5 miles the gold-fields of Rokewood, Scarsdale, Smythesdale, and Haddon, south of the Main Divide, and on the north thereof, and also of an intervening area of exposed granite, are the workings of Mount Greenock, Talbot, Amherst, Maryborough, Timor, Dunolly, Goldsborough, Moliagul, McIntyres, Wehla, and Wedderburn, forming an almost unbroken chain of gold-workings nearly 70 miles in length.

Observation of these phenomena, and the record of experience gained in similar researches in other parts of the world, all lead up to the conclusion that, by whatever natural processes the quartz veins were formed and gold deposited in them, the latter operation reached a high degree of development only in certain groups of strata, in certain veins and lodes in those groups, and in certian zones and "shoots" in the veins or lodes. These belts sometimes widen or contract as to the breadth over which gold occurs in them ; barren intervals are met with, and in some places there are even indications of a complete disappearance of the auriferous character; but nevertheless the main facts stand good, that the above described long strips, having an approximately meridional course across the country, are more or less continuously auriferous for scores of miles, while intermediate strips presenting the same geological features—Silurian rocks, quartz reefs, water-worn gravels, &c.—are poor in or destitute of gold.

The foregoing observations will have sufficiently explained the grounds which justify the proposition that, short of actual experiment, the surest indications as to the probable quality of a lead in any particular locality are to be obtained by noticing the position of that locality with respect to known auriferous and non-auriferous ground, and the strike of the Silurian rocks therein. According as the locality is on the prolongation of the direction of the strike of the Silurian rocks from rich or poor shallow ground, so is the gold likely to be found plentifully or sparingly in the deep ground at that place.

Where a deep lead takes a general course across the direction of strike, it will be found to be alternately rich and poor as it crosses the prolongations of the belts of gold-bearing or barren country proved in the shallow ground on either side.

Where a lead takes its course along the strike, it is likely to be continuously rich if on the prolongation of an auriferous belt, and continuously poor if on that of a barren one.

Local variations in the quality of deep alluvial ground under either of the above conditions may always be expected according to the varying widths of the alternate belts, the occasional breaks in the auriferous ones, the position and length of the auriferous quartz reefs, and the richness and extent of the gold-bearing "shoots" in the latter.

The position in which the alluvial gold occurs most plentifully, whether in the main leads themselves, or in branch leads, in the deepest part of the gutters, or on the slopes of the bed-rock, has been influenced not only by the forces which eroded the lead channels and conveyed the gold into them, but also by the position with respect to the leads of the auriferous belts or veins. A lead winding along the course of a single line of auriferous reef would be rich or poor according to its position from point to point with respect to the reef and the gold "shoots" therein, and the position of the gold, whether in the gutter-bed or on the high reef, would be greatly influenced by the same conditions.

A main lead running along a barren belt, and fed by tributaries crossing an auriferous one lying parallel on either side, would be itself poor, but the tributaries and reef washes on the side adjacent to the auriferous belt would be rich.

Generally summarising, the main conclusion arrived at is that the quantity of alluvial gold deposited from point to point along the leads necessarily depended on the relative position and richness of the local auriferous matrices, which, with the containing Silurian rock, were worn away during the erosion of the lead-channels; that on the continuation of any given lead, proved rich to a certain point, the alluvial deposits would not prove payable for a single mile further, if so much, if the Silurian rocks denuded on its extension beyond that point had not originally contained auriferous veins.

Non-apprehension of these considerations may often lead to mistakes, arising out of the tendency on the part of miners to lay undue stress on the fact of any particular run of deep ground being the continuation of deep ground proved rich at some distance off. As an imaginary instance of three mining companies—*A*, *B*, and *C*—two, *B* and *C*, are searching, by means of boring, for the continuation of a rich lead worked in the ground of *A*. *B* and *C* both prove deep ground, but that of *B* is evidently the continuation of the *A* lead, while that in *C* is a different one, previously unknown. *B* rises and *C* falls in market value in consequence. It is quite possible, however, that the deep ground in *C* may be on the prolongation of strike of the Silurian bed-rock in *A*, while in *B* the *A* lead has diverged and is running over the strike of a non-auriferous belt. Under such circumstances, the results of actual exploration would be likely to show that the lead in *C* was more valuable than the continuation of the *A* lead in *B*. In fact, a shallow reef-wash in *C* would be far richer than the gutter in *B*.

Investors in alluvial mines would do well to realize that the richness of any deep or shallow deposit therein depends far more on its position with respect to a proved auriferous belt than on the mere fact of its being an extension of some deposit proved rich elsewhere, but not on the same line of strike with it.

Many instances could be cited where a lead proved rich in one portion has been traced for a certain distance, and having been found to get poor, all operations on its further extension have been abandoned, and yet were such a lead tested further on, where it could be seen to cross or turn along the prolongation of strike of the Silurian rocks in some proved auriferous tract, or where it returns to the prolongation of strike from where payable gold was found in itself, the probabilities are, that it would be found to improve again in its quality.

Applying all the foregoing facts and observations to the consideration of the probable value of the leads of the Deep Creek and Loddon Valley, from the Madame Berry to Laanecoorie, it can be seen that everything depends on what was the auriferous character of the veins contained in the Silurian rock denuded during the formation of the lead-channels. We know, as a fact, that a line from Creswick towards Laanecoorie runs right along the central portion of the concealed middle section of the great Ballarat auriferous belt, proved so richly gold-bearing on the exposed northern and southern sections. We see that so far northward as the Madame Berry mine, no important falling-off in quality has taken place, and it is only reasonable to suppose, that the auriferous character, though it may be here and there broken in continuity, and variable as to the breadth it extends over, will be maintained by the belt of Silurian rocks and by the leads overlying it, for the whole distance to Laanecoorie, and perhaps even to the parallel of Inglewood. The existence of gold in the quartz outcrop at Clarke's east of Horseshoe Hill, and in reefs in the exposed Silurian rock along part of the Deep Creek to the north-west, are very important indications as to the probable continuance of the auriferous character of the leads.

It has been remarked that between Majorca and the Loddon, or thereabouts, granite is likely to form the bed-rock, and that the quality of the leads there may deteriorate on that account. This is an erroneous impression, as there is good evidence that the Silurian rocks form the bed-rock continuously.

There is a small granite area east of Majorca, but to all appearance quite isolated, as the Silurian rock bounds it for the greater part of its margin near the Deep Creek. The Silurian rock showing along the Loddon, near Joyce's Creek, and the exposure in the middle of the plains, near the Moolort railway station, all indicate that, if any, there cannot be much granite forming the bed-rock of the leads, and, if it does, it can only be for a small extent, and is unlikely to in any way affect the value of the alluvial deposits. The granite east of the Loddon is unlikely to extend far under the plains west of the river. On the whole, I feel justified in expressing the opinion that nowhere do all the most favorable indications combine more strongly in the promise of a successful mining future, than in the case of the Deep Creek and Loddon Valley, from Creswick to Laanecoorie, not only as regards the main leads, but also with respect to the tributaries, the reef-washes, and the quartz reefs, which remain undenuded in the Silurian bed-rock. The Clunes, Mount Greenock, and Talbot lead systems are described in the report specially relating to the geological survey of the district containing those gold-fields.

The country through which pass the leads of the Bet Bet system has not yet been geologically examined other than cursorily, and I therefore defer to a future occasion any special remarks on those leads, save that the general suggestions already given apply to them equally with those of the Loddon Valley, &c., namely, that the auriferous quality of leads is likely to be good or bad, according as those leads pass over the extension of belts of country proved gold-bearing or barren in shallow ground.

REGINALD A. F. MURRAY,
Geological Surveyor.

Talbot, January 13th, 1883.

REPORT ON THE GEOLOGICAL SURVEY OF THE AREA CONTAINING THE CLUNES, MOUNT GREENOCK, AND PART OF THE TALBOT AND AMHERST GOLD-FIELDS.

The geological survey of the Clunes and Mount Greenock gold-fields was commenced in 1877 by Mr. Norman Taylor, who had made considerable progress with the work when operations were suspended consequent on the reductions of 1878. The survey was resumed by me in May, 1881, and a map representing an area of 100 square miles was completed July 1st, 1882. An additional strip of 20 square miles has subsequently been geologically surveyed to the north of and adjoining the former area, and the completed map, now in course of publication, represents an area 12 miles north and south by 10 miles east and west, or 120 square miles in extent.

The north-east corner is 2 miles north of the north-west corner of the Glengower geological map, and the eastern boundary adjoins the western boundary of the Glengower, and of a portion of the Creswick geological map.

The southern boundary coincides with the northern boundary of the Learmonth map; the country to the west and north has not yet been geologically surveyed.

The north-west portion of the area surveyed includes the southern portion of the Talbot and Amherst gold-field and the Mount Greenock workings.

Mounts Greenock, Glasgow and Cameron stand 2 miles within the northern boundary line, and the Mount Beckworth range is in the south-western portion of the area. The entire area is within the watershed of the Loddon River. The eastern portion is traversed by Coghill's, Creswick's, and the Bullarook or Birch's creeks, all of which unite and form the Tullaroop or Deep Creek. The western part is traversed by McCallum's Creek and its tributary, Stoney Creek, besides other branches heading from the Mount Beckworth range. McCallum's Creek passes out of the area about 2 miles east of Talbot, and the Back Creek, passing through Talbot, crosses the north-west corner of the sheet.

The formations occurring within the area, and their order of geological sequence, are indicated in the subjoined list :—

Alluvial.

	Post-Tertiary.	*"Most Recent," or now in progress.*	Deposits of earth, loam, clay, sand, and gravel, &c., in beds of gullies and flats bordering creeks.
		"Recent."	Clays, sands, gravels, ironstone, conglomerate, &c., immediately subsequent to the newer volcanic lava-flows.
	Upper Tertiary.	*Newer Volanic.*	Basalt, lava, scoria, volcanic ash, &c.
		Upper Pliocene. (*"Older" gold-drift.*)	Clay, sand, gravel, conglomerate, &c., of the deep leads beneath the volcanic layers, or of deposits which, though not covered by basalt, are of contemporaneous origin with the lead-drifts.
		Lower Pliocene. (*"Oldest" gold-drift.*)	Gravels, conglomerate, &c., older than those of the leads and forming cappings on hills and spurs.
Palæozoic.	Igneous.	*Trappean.*	Greenstone, syenite, &c., forming dykes or intrusive masses.
		Hypogene.	Granite.
	Sedimentary.	*Lower Silurian.*	Sandstones, slates, shales, &c., constituting the "bottom" or "bed-rock" of the gold-workings.

Granite.

Though actually younger geologically than the Silurian rocks, as indicated in the above list, the granite is lowest in stratigraphical position, and is therefore the first formation to be here described.

Either as the surface formation, or as the bed-rock underlying the Tertiaries, granite occupies in the south-western part of the sheet about one-fourth of the entire area. The extremity of a granite spur from the Main Divide extends into the southern portion near the south-west corner; separated from this by a strip of volcanic country is the Mount Beckworth range, of which the highest point is 2,087 feet above sea-level.

Rising abruptly from comparatively level country, this range, with its rugged—in places almost precipitous—spurs, strewn with "tors" and huge bare masses of granite, forms the most conspicuous natural feature near Clunes.

To the north-west of Mount Beckworth range, and separated from it by a narrow strip of volcanic country, is another granite range, somewhat lower and less rugged, which slopes away westward and northward to McCallum's Creek.

The general character of the granite is ordinary ternary—quartz, orthoclase felspar, and black mica, coarse to medium grained, and more or less intersected by joints, which, in places, present the appearance of stratification planes.

Among Mr. Norman Taylor's notes mention is made, in addition to the ordinary granite, of the following varieties:—Granite, ternary, porphyritic with large patches of quartz, and also with felspar crystals. Half-granite (aplite), binary; quartz and orthoclase, scattered mica scales, sometimes porphyritic with patches of quartz and a few scales of mica, fine grained and granular. Syenite granite (quaternary), medium-grained common ternary, base porphyritic, with crystals of black hornblende and coloured brown by hydrous iron oxide; part of felspar appears to be "oligoclase."

A few quartz reefs and veins occur in the granite, and one of them, at its surface outcrop, is of great thickness, but none extend far longitudinally, nor do they present the appearance of being auriferous. Veins of felspar and of fine-grained felspathic binary granite are not uncommon.

With reference to the weathering of hollows and caves in granite, it may be observed that, at several places in the Mount Beckworth granite area, there are to be seen small but well-defined caves, or deep hollows, at the bases of some of the jutting masses of granite; in one or two cases, a passage extends through from side to side.

Some time ago it was stated, with reference to a reported discovery in Northern Australia of relics of the explorer Leichardt, that they were found in a cave within a mass of granite, the entrance to which cave was concealed by sand.

Doubt was cast upon the probability of such a cave existing in granite, but since observing the imperfect ones at Mount Beckworth, I can readily conceive that, under favorable conditions, such a cave might very readily be naturally produced. A soft portion at the base of a projecting mass would be eaten into by atmospheric action, and were the interior of the mass softer and more friable than the outside crust—which might be caused by the exudation of iron or silica towards the surface—farther decay, and the frequenting of the cave by animals or reptiles, would effect still further enlargement and upward erosion, until the roof of the inside was higher than the entrance; the subsequent concealment of the entrance by débris banked-up from the outside would be very simply effected, and the result would be a hidden cave, such as is represented in the accompanying section (Fig. No. 1, page 42).

At the time of the reported discovery in Northern Australia above referred to, a friend wrote informing me that he knew of the finding of just such a cave in McIntyre's Ranges, by a person engaged in digging out a snake which had been seen to enter a small hole in the earth near the base of a mass of granite.

LOWER SILURIAN.

With the exception of the granite area above described, the Lower Silurian strata form the bed-rock of the whole area mapped, either appearing at the surface or underlying the Tertiaries. As surface outcrops, these rocks constitute several groups of low ranges separated from one another by volcanic areas.

In the north-west is portion of a tract of Silurian ranges, the leading ridge of which forms the watershed between Stoney and McCallum's creeks on the south and east, and the gullies falling into Back Creek on the north. North and south from Mount Glasgow extends an area of low ranges, the main ridge of which forms part of the watershed between the Deep Creek on the east, and a network of gullies falling into McCallum's Creek on the west.

Separated by a volcanic strip from the last mentioned, is a small group of low Silurian hills, about 2 miles west from Clunes, and forming portion of the watershed between Coghill's Creek and a large creek running into McCallum's Creek.

The small outcrops at Clunes, surrounded on all sides by basalt, complete the list of areas in which the Silurian rocks appear as the surface formation within the district mapped.

There are no special features to note in the lithological character of the exposed Silurian rocks; the same varieties of slate, sandstone, shale, &c., common in other districts are met with here, the harder bands frequently standing out in sharp bare ridges on the more prominent hills and spurs.

The general magnetic bearing of strike is about north 10° west, though it is rather more westerly in the north-west corner of the sheet, and more nearly north in the ranges south from Mount Glasgow. The actual junction of the Silurian and granite is nowhere distinctly visible, as the boundary is everywhere hidden by Tertiary or Post-Tertiary deposits, but in some places a change is noticeable in the character of the Silurian rocks at the exposures nearest to the granite, the schists assuming there a spotted nodular character indicative of contact metamorphism.

Certain bands and groups of bands in the north-west part of the sheet are highly pyritous, though the pyrites are usually so decomposed near the surface that only the cubical cavities, partly filled with oxide of iron, remain to indicate the former presence of the mineral.

Among Mr Norman Taylor's notes are mentioned the following varieties of rock constituting some of the Silurian bands :—Argillaceous mica schist, nodular

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metamorphic schist, shows weak, silky lustre and contains fahlunitic grains in abundance; cleavage uneven. Metamorphic standstone (hornfels), hard, finely crystalline, granular and compact.

Quartz rock, finely granular, dense, and hard, near granite boundary, Mount Beckworth.

Clay slate, lode slate, gangue slate, black lode slate, fine-grained grey sandstone rather cherty, slightly micaceous slate impregnated with pyrites and traversed by quartz veins.

Carbonaceous slate, fissile, cleavage irregular; weak satiny lustre. Clunes.

TRAPPEAN.

One of the most noticeable geological features in the north-western part of the sheet is the intrusion through the Silurian rocks of several dykes and masses of igneous rocks, in some places solid and undecomposed, in others more or less decayed and altered. They are not continuously traceable along the surface for long distances as such dykes frequently are, but form isolated outcrops of from not more than a chain to half-a-mile in length. Their bearing, in the direction of their length, coincides with the strike of the Silurian rocks, and they vary from a few feet to as much as a hundred yards in width.

In one or two cases the outcrops appear at intervals along a line of strike, like distinct pinnacles of the same dyke protruding through the Silurian strata.

The most conspicuous of these masses occurs on a hill known as the Granite Hill, or Green's Hill, between the western head of Nuggety Gully and the fall towards Kangaroo Flat. Portion of the rock is decomposed, but much of it is not so, and stands out in considerable masses, or "tors," weathered like granite. At the south this dyke ends off abruptly against the Silurian rocks, though a branch dyke about 2 feet thick continues for a few chains further before thinning out and becoming lost to view. At the north the main dyke tapers away gradually and disappears, though further on in the same direction a thin and quite decomposed dyke accompanies a quartz reef worked by Messrs Walker and party. The entire length exposed at Granite Hill is about half-a-mile, and the width about the central and southern portion from 200 to 300 feet. The Silurian rocks show signs of partial metamorphism and induration near their contact with the dyke.

At the southern end the dyke stone is medium to coarsely granular, decomposed, and, as described by Mr. N. Taylor, is an "epidote granite" ternary, flesh-coloured orthoclase felspar, green epidote (pistacite), and some quartz. About the central portion, on the summit of the hill, the rock is a pink syenite granite, fine to medium grained, composed of flesh-coloured orthoclase, and some plagioclase felspar, greenish-black hornblende, and a very little quartz, with some scattered chlorite. At the northern end the pink hue disappears, and the rock becomes a grey, fine-grained syenite granite, rich in plagioclase.

The rock in the central portion would, I believe, prove a very valuable ornamental building stone, as it appears to be of very durable character, good colour, and susceptible of a high polish. Were a quarry opened, a large quantity would be available, and obtainable in blocks fully 6 feet, if not more, each way.

Near the northern sheet boundary on the west side of Long Gully, and about a quarter of a mile from the railway line, is another intrusive mass of an oval shape, about 10 chains long and 7 wide, of grey syenite granite with a pinkish tinge, containing some plagioclase very similar to, but somewhat finer-grained than that last described; this also would be a valuable stone for monumental and other purposes, and could be quarried in large blocks.

In the ranges between the two large syenite dykes are several smaller dykes composed of a rock of peculiar mineralogical character. The base is siliceo-felsphathic, compact, and greenish-grey in colour, and through it are patches and porphyritically embedded crystals of felspar, with smaller and more sparingly distributed pieces and crystals of a black mineral resembling augite, and numerous grains and geodes of translucent chalcedonic quartz. The latter have evidently filled what were vesicles in the stone, and the quartz geodes so formed, standing out on the weathered surfaces, present the appearance of small rounded pebbles. A dyke of the same character occurs on the north bank of the Back Creek a short distance west of the Talbot racecourse.

In driving through the bed-rock at the Hoffnung mine, near Mount Greenock, a large decomposed dyke, resembling syenite, was passed through, and in the ranges south from Mount Glasgow are several small outcrops of dyke-stone, all of one character, viz., drab or light-brown, felspathic, finely crystalline granular base, with crystals and stalks of hornblende, and occasional green specks, where that mineral has decomposed. The rock has evidently been altered by decomposition, but would appear to have been at one time a very hornblendic granite.

Mr. A. W. Howitt, F.G.S., kindly furnished me with some notes on his microscopic examination of the granite hill dyke, and another dyke in the same locality. They appear as an Appendix.

LOWER PLIOCENE (OLDEST GOLD-DRIFT).

The term "oldest," as applied to these deposits, is perhaps a misnomer, inasmuch as there are elsewhere gold-drifts of more ancient date, but it is correct so far as this and adjacent mining districts are concerned, and is employed to distinguish certain gravels and conglomerates, which, from their position, are evidently older than the deposits in the leads, the channels of which have been eroded through them to a deeper level. They consist of ferruginous and siliceous conglomerates, or cemented gravels, sandy ironstones, and loose quartz gravels, and in places flank the slopes of the Silurian ranges, capping some of the less elevated hills and spurs, but not reaching the higher points. In the area under notice they are found on the slopes towards McCallum's Creek, of the Silurian ranges extending from Dunach, south of Mount Greenock, towards Beckworth. The beds incline towards the creek valley, in places passing beneath the basalt, and it is often very difficult, in such cases, to distinguish between them and the later drifts of the leads.

As now visible, they occupy detached areas, separated by gullies that have cut through them into the Silurian rocks, but they evidently were at one time far more extensively and continuously distributed. Their mode of occurrence suggests marine rather than fluviatile action, as having been the agency by which their materials were denuded from the Silurian rocks, and rolled into sand and gravel.

The distinction between the drifts respectively classed as "oldest" and "older" can be seen at Talbot, where a strip of "oldest" drift (evidently a continuation of the Good Woman's Hill and Ballarat Hill gravels), occupies a broad shelf of the Silurian rocks, which slope up from under it on the south-east, and dip sharply into deep ground containing the "older," or lead-drift, on the north-west.

What is known as the Scandinavian lead is the auriferous portion of this area of "oldest" drift, and at its northern extremity, outside the sheet boundary, a very sudden drop of about 60 feet was encountered, where it had been cut through by, and its gold re-deposited in the bed of, the "older" lead. The accompanying sectional diagram (Fig. No. 2) illustrates the occurrence. (See page 42.)

The gravels worked to the east under Mount Greenock, in the Union mine, appear to be of the period classed as "oldest" gold-drift, as they are high above the level of the deep ground.

There is probably much gravel of this formation beneath the volcanic areas, where it will be found covering hidden spurs, low ridges and shelves of the Silurian rock, at the sides of the deep leads.

UPPER PLIOCENE (OLDER GOLD-DRIFT).

Under this designation are included the loose and cemented gravels, sands, clays, and other deposits of the deep leads themselves, and also such as are clearly of contemporaneous origin, though not covered by volcanic rock.

Only a very small aggregate surface area is occupied by these deposits within the area mapped, but, were the volcanic rock and sedimentary coverings of later date

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removed, they would be found occupying all the deeper hollows and channels in the Silurian rocks. Some of the shallow lead-gravels in the north-western part of the sheet are clearly of this period, though covered by recent deposits. The Nuggety Gully lead, for instance, though commencing in, and for some distance confined to, the bed of a gully, is found, on reaching the wider flats, to cross several spurs and branch gullies, and to take a course independent of that of the present drainage channel. So also with several others of the same character. The general trend, however, of all these shallow leads, more or less approximates to that of the present creeks, and—as in most cases proved by actual mining—they ultimately pass beneath the basalt, and there join the larger leads, to which they are tributaries. In the Mount Greenock lead occur fossil fruits similar to those of Haddon and Ballarat, principally ***Spondylostrobus, Plesiocapparis***, and ***Conchotheca.***

NEWER VOLCANIC.

More than one-half the entire area represented by the sheet is basaltic on the surface; the most extensive tract is that in the eastern part of the sheet extending from the southern to the northern boundary line, and forming part of the western edge of the great volcanic area which extends northward, down the Deep Creek and Loddon Valley, eastward to Joyce's Creek, and southward to Ballarat. The basalt extends along the southern portion of the sheet, separating the Mount Beckworth range from the granite spurs to the southward, and widens out westward, where it forms a tolerably wide plain bordering McCallum's Creek; this plain narrows towards the northern sheet boundary at Mount Greenock, and then to the north widens again, and joins the basaltic plains of the main volcanic area near Carisbrook. The low Silurian range 2 miles westward from Clunes, the Mount Beckworth range, and the granite range north-westward thereof, with the Silurian ranges extending northward to Mount Glasgow and thence to Majorca, are all isolated from one another by strips of basalt, which are themselves connected either way with the larger volcanic areas.

There appears to be little or nothing worthy of note in the character of the basalts within the sheet, to distinguish them from those of other districts which have been described before. The same general mineral composition; the same variations from dense and compact to porous and vesicular, are noticeable here as in other districts. Some interesting studies are obtainable in the natural sections exposed in small cliffs along the Deep Creek, where there may be seen curious alternations in hardness, texture, degree of decomposition, and other characteristics, suggesting the idea of a number of thin, successive flows, which cooled under varying conditions.

Among the minerals occurring in the basalt near Clunes, the following were noted by Mr. Norman Taylor, in addition to the ordinary constituent and accessary minerals:—Chabasite, phacolite (herschelite), mesolite, pale-blue mesolite, hyalite, arragonite, heulandite, and gmelinite (in thin six-sided plates).

There are numerous extinct points of volcanic eruption shown within the sheet. In the north portion are Mounts Greenock, Glasgow, and Cameron, with two minor points, known as the Middle Hill and Green Hill. Three miles north-east from Clunes, just within the eastern sheet boundary, is a volcanic cone, apparently one of the minor eruptive points of the extinct volcano to the east, known as McDonald's Hill, and shown on the Glengower geological map.

South and south-west from Clunes are several other minor points of eruption, and south-west of the Mount Beckworth range is a group of three or four, of which Mount Gap is the principal. All these hills are more or less composed of scoria, basaltic pumice, and volcanic ash, with occasionally numerous ejected fragments of granite and Silurian rocks.

Along the western side of Mount Glasgow, at the junction of the volcanic and Silurian rocks, the former consist of beds of volcanic ash-conglomerate, composed principally of fragments of the latter. South from Middle Hill and Green Hill, the surface is strewn with large ejected masses of hard Silurian sandstone and schist, together with a few rounded quartz pebbles, indicating an eruption through Pliocene gravels.

On the volcanic hills south-west from Mount Beckworth the volcanic ash is composed chiefly of granite sand, and there are also to be seen large ejected masses of granite, together with boulders and pebbles from the Pliocene drifts. On a volcanic hill just within the southern sheet boundary and south-west from Clunes, it is stated that a nugget was ploughed up many years ago ; should this be well substantiated, it may be regarded as a pretty sure indication that the deep ground which undoubtedly exists in the vicinity is auriferous, as the nugget could only naturally come in such a position by being ejected during an eruption through auriferous gravels.

POST-TERTIARY.

Regarding the basalt of the newer volcanic epoch as marking the close of the Tertiary era, and all deposits subsequent thereto as Post-Tertiary, the next formation in geological sequence is that distinguished by the term "recent," consisting of deposits of clay, sand, angular and waterworn gravel, &c., which began to accumulate immediately after the lava-flows, and are composed of detritus washed down from the higher granite and Silurian ranges over the edges of the lava-flows, covering their lines of junction with older rocks, and spreading over both in some places to a considerable depth. They also form wide flats, evidently of older date than, and above the level of, those classed as alluvial, or "most recent" deposits.

On the slopes from the granite hills, the "recent" deposits are of considerable extent and thickness, and are made up wholly of granitic detritus, sometimes re-formed into a hard cement.

On the slopes from the Silurian ranges, clay, and angular or partly rounded quartz-gravel, occasionally cemented by iron, are the prevailing forms. On the volcanic rocks, clay and pisolitic iron cement, with conglomerate cemented by iron exuded from the basalt, form the most frequent covering, often quite concealing the basalt over large areas.

The alluvial, or "most recent" deposits, are those composing the flats bordering creeks or occupying the beds of gullies and swamps. They are composed of all materials, according to the character of the adjacent rocks, and are frequently redistributions of some of the "recent" and Tertiary deposits. They are in many places subject to increase by existing geological action.

GEOLOGICAL HISTORY.

The geological history of the area represented on the map, and also of the adjacent country on either side, is very similar to that of the Ballarat district on the southern slopes of the Main Divide.

It is needless to enter into the history of the Silurian and granite rock-foundation, further than to briefly sketch the generally accepted theory, which appears to apply more or less to these rocks throughout the world.

The character of the original foundation on which the Silurian rocks were first laid down as horizontal sedimentary layers, is a matter of conjecture. So also, but with rather more certainty, are the natural processes by which those once horizontal layers were folded and compressed until they assumed the highly inclined, and sometimes vertical position, in which they are now seen. It is, however, certain that the granite lying beneath, and in places protruding through, the Silurian rocks, is a product of later date than they, as regards its present structure, though it probably embodies, in an altered form, the materials of the original foundation with the absorbed and transmuted material of the lower edges of the folded and inclined Silurian layers. This process of alteration into granite, whatever its details may have been, appears to have been effected mainly by the action of heat under pressure, and at great depths below the surface of the period during which it took place, and the appearance of granite as a surface rock is due to the removal of the rocks which once covered it.

Such masses as the Mount Beckworth and other granite ranges can be regarded as projections where the invasive action of the nether-formed granite has extended higher than in other places, and which were laid bare by denudation on account of their prominence.

Nowhere can evidence be seen that the Mount Beckworth granite is an upheaved mass. The Silurian strata to the north abut on it without a sign of disruption, while their partial metamorphism near the plane of contact simply tends to confirm the theory as to an invasive and transmuting action, and the absorption of their lower edges and ends by the once heated mass below.

The geological period to which this transmutation of other rocks into granite is referable, is clearly later than that of the deposition of the Silurian strata; but reasoning from geological evidences in other districts, it must have taken place, in this country, early in the Palæozoic era, though the exposure of the granite as a surface rock may not have been effected until far more recent times.

A leading fact to be borne in mind in considering the geology of this district, whether in a purely scientific aspect, or with respect to its mining resources, is the huge denudation that has taken place since the uptilting of the Silurian rocks, and the incalculable amount of material that has been planed off and removed from their upper edges. Diagram No. 3, subjoined (see page 42), will perhaps explain better than words the action to which these rocks have been subjected above and below.

It is by no means an exaggerated estimate to assume, that a vertical thickness of uptilted Silurian rocks, amounting to many thousands of feet, has been removed by denudation, and that the existing surface of the Silurian rocks was once that depth below what was the surface during the middle and upper portions of the Palæozoic era.

The above-mentioned diagram (No. 3) represents a section across the strike of the Silurian rocks. There is, however, another feature worthy of notice, and highly important in a mining sense. This is that, though the Silurian bands on their strike may terminate against granite masses, the next Silurian areas in the same lines of strike, are likely to contain the continuations of the same bands, subject, of course, to lateral displacement by "faults," and alterations in the actual bearing of the strike.

Taking, for instance, the Mount Beckworth range, it may be seen that the Silurian rocks, which abut on the granite to the north, are interrupted by it on their strike; but were the general direction of strike followed southward, and the granite crossed, the Silurian rocks abutting on its southern margin would probably be found to be the continuations of those terminating on the northern, the intervening portions having been partly absorbed into the composition of the granite, and partly removed by denudation. The practical application of this theory will be discussed in treating of the auriferous deposits.

In this and the surrounding district, for many miles in every direction, there are actually no representatives of the great range of geological groups intervening between the Lower Palæozoic and the Upper Tertiary formations.

Rocks of Upper Palæozoic, Mesozoic or Lower Tertiary age may have once been developed and subsequently have been entirely removed; but whether this was the case or not, the fact remains that between Lower Palæozoic and Upper Tertiary times, the Silurian rocks were worn down to an incalculable extent, and that the Upper Tertiary gravels, classed as "oldest" and "older" gold-drift, are the concentrated residue resulting from the denudation of the entire period.

Whatever the changes of conditions and oscillations of level during the long ages prior to the Upper Tertiary epoch, it would appear that,—at all events during the earlier periods of that epoch,—marine action played a part in the formation and distribution of the Pliocene gravels up to elevations of nearly 1,000 feet above the present sea-level, and to such action may be attributed many of the deposits here classed as "oldest" gold-drift. With emergence of the land to a higher elevation above the sea, fluviatile action came into play. The widely spread gravels were cut through, and in places removed and re-distributed in more deeply eroded channels, leaving disconnected areas and patches intact. That the leads were rivers at the latter part of the period during which they were formed appears evident, though it is very probable that, owing to the difference in elevation, fluviatile action may have set in at a later date about the parallel of Mount Greenock than at Ballarat and Creswick. Hence the lead-gutters of the latter gold-fields are more defined, and the auriferous deposits in them more concentrated, than in the case of the Mount Greenock lead.

The volcanic lava-flows which closed the Upper Tertiary period covered in all the main river valleys then existing, and also extended back up many of the tributaries. On their cessation, fluviatile and atmospheric action resumed the work of denudation, and the courses of the present creeks and rivers were eroded through and along the edges of the basaltic areas.

The deposits classed as "recent" appear to be among the earlier effects of this Post-Tertiary denuding action.

Some interesting and instructive phenomena in connexion with Post-Tertiary geology are to be observed along the slopes of the tract of Silurian ranges extending north and south from Mount Glasgow, and forming a portion of the divide between the drainage area of Deep Creek on the east, and McCallum's Creek on the west.

For nearly the whole length of the tract referred to, it is noticeable, that the fall westward towards McCallum's Creek is tolerably abrupt, and the heads of gullies on that side are split up into numerous short branches rising among steep broken spurs and ridges. Some of the highest points of the ranges are off to the westward of the actual watershed line.

On the east, towards the Deep Creek, the slopes are very gentle, the gullies wider apart, and many of the broad, nearly level, depressions occupied by "recent" deposits head back to low saddles, at the very verge of the more abrupt fall towards the west.

In one case, near the Eglinton swamps, a tongue of basalt, from the great eastern volcanic area, extends back under the "recent" deposits, and shows from beneath them at the head of a gully running into McCallum's Creek. In another, the head of an auriferous lead, trending from south of Mount Glasgow towards Mount Cameron, is cut off by the heads of steep gullies, which also run into McCallum's Creek.

The reasoning suggested by these facts is that, prior to the lava-flows, and during the time the deep leads were rivers, the dividing ridge of the tract of ranges referred to was further west than at present. The main channel of the Mount Greenock lead, on the west, was then, as now, nearer to the range than was the main trunk lead of the Deep Creek lead system. There were few, if any, tributary leads heading from the range and going to the west, but several to the east.

The lava-flows that covered in the eastern lead systems did so to a greater elevation than did those which covered the Mount Greenock lead, and, in the former instance the lava extended back up the tributaries, nearly to the divide between the two systems. The result was that on the west, the fall being greater and the distance shorter, the slopes of the ranges in that direction were chiselled by denudation into more abrupt and broken outlines, and the heads of the gullies were cut back towards the verge of the eastern basaltic area; while on the east, the materials denuded from the range overspread the tongues of basalt that filled the heads of tributary leads, and formed widely spread accumulations, there being not sufficient fall to allow of erosion into sharp outlines and entire removal of denuded material. The sketch-section (No. 4) opposite page 42, illustrates the foregoing remarks, and further examples may be observed in the physical and geological features as recorded on the geological map.

DEEP LEADS AND AURIFEROUS BELTS.

The deep leads of the district, and their analogy in their general trends to existing watercourses, have already been generally described in a paper on the deep leads of the Loddon Valley, and observations therefore will here be confined to the sub-basaltic leads within the area represented by the Clunes and Mount Greenock geological map. It is uncertain whether the main trunk lead of the Deep Creek lead system, or that formed by the combination of the Rocky lead from Bullarook with the Madame Berry and other Spring Hill leads, will be found to come within the eastern part of the area now under notice, or whether it traverses the western portion of that represented by the Glengower geological map. The latter course seems, at present, the most probable. Apart from the Deep Creek, or eastern lead system, there is, beneath the great basaltic area south and south-west from Clunes, an important western lead system of several branches, between the two principal of which the Silurian outcrop at Clunes appears to be portion of the dividing ridge. One main branch passes to the east of the town, and is certain to be joined by the Lothair lead and the lead found by the Clyde Company ; it appears likely to maintain a course approximating to that of the Deep Creek, and to join the main eastern lead system in the direction of Horseshoe Hill.

The other branch seems to lie beneath the basaltic area west of Clunes, and will most likely run for some distance parallel with, and westward of, the Deep Creek, finally turning eastward and joining the other leads in the neighbourhood of Horseshoe Hill.

Between the low Silurian range, about a mile and a half westward of Clunes and the Mount Beckworth range, is a long narrow strip of basalt, evidently underlaid by deep ground. A similar strip, but broader, runs along the western side of the Mount Beckworth range and then turns easterly, skirting its northern slopes and joining the other basaltic area. The two leads covered by these basaltic strips are likely to unite in one lead near the railway line, two and a half miles northwesterly from Clunes, and thence trend north-easterly by the Eglinton swamps, meeting the lead passing immediately westward of Clunes, and joining the main system in the direction of Horseshoe Hill.

Several tributaries, heading from the ranges south of Mount Glasgow, come in from the west, and trend towards the main trunk system.

As to the existence of all the leads above mentioned, the geological evidences are conclusive, though the actual positions can only be broadly indicated. Of the entire group, only the Lothair lead, the reef-wash gravels beneath the basalt adjacent to the Silurian outcrop at Clunes, the lead to the north found by the Clyde Company, and the head of a tributary lead starting from south of Mount Glasgow, have been worked or even tested. The Bute and Downes G. M. Company are now working the continuation of the Lothair lead with encouraging results. The lead in the Clyde Company's ground, though auriferous, has so far proved unremunerative, and the Mount Glasgow lead, worked pretty exhaustively and with fair results in shallow ground near its head, passes into private property, where a Chinese party are now working eastward of the Mount. Beyond there the lead is untested, though its course is pretty well defined to between Splitters' Creek and Mount Cameron, on its way to join the Deep Creek lead system. Beneath that portion alone of the Clunes, Eglinton, and Glengower basaltic area, which is included in the Clunes geological survey, there must be an aggregate length of not less than 40 miles of the beds of leads, and, of this estimated total, not more than a mile and a half has been actually worked.

That the entire length indicated is likely to be payably auriferous would be far too sanguine a hope, but that portions considerably greater than those already worked will prove remunerative, is only a reasonable expectation.

In searching for such portions, there must necessarily be much risk of unsuccessful experiment, owing to the wide extent of the basaltic covering around Clunes, and the concealment thereby of many indications which, if visible, would serve as useful guides ; but there are principles and facts which, if attended to, will reduce the risk of failure within the smallest possible limits, though neither geologist nor miner can, with confidence, assert the existence of payable ground until actually proved. The generally recognised principles with regard to the occurrence of alluvial gold are—that it has been originally disintegrated by denundation from auriferous quartz veins, and that, owing to its high specific gravity, the free gold so disintegrated has not been removed by natural agencies very far from its matrix in fragments of appreciable size or in large quantity.

The richness of leads must therefore depend on their position with regard to the belts or lines of auriferous matrix rock, and on the extent and richness of such matrices, modified by the conditions under which the lead-gravels occur, whether in a widely-spread or in a concentrated form.

In the paper on the leads of the Loddon Valley, it has been pointed out that the Spring Hill group of leads are on the continuation of the great auriferous belt of Ballarat and Creswick, and that, on crossing the basaltic plains in the same direction, the first exposed Silurian country met with contains the rich reefs of Tarnagulla and its vicinity, thus justifying the inference, that the belt is likely to maintain its auriferous character beneath the basalt between the two localities, and that the leads on, or adjacent to its course, will prove remunerative.

The Clunes reefs constitute another nearly parallel auriferous belt, which, though only traced for a short length, and within a narrow area, has yielded a very important proportion of the entire gold yield of Victoria. The width of the belt is unknown, little or no trial having been made to any distance on either side of the proved reefs.

The course of the southern prolongation of the belt is hidden by basalt for more than 20 miles from Clunes, so that actual experiment is required to prove the continuance of its auriferous character, but, reasoning from experience elsewhere, there appear good reasons for believing that leads, or other detrital deposits on the course of the southern extension of the Clunes belt, are likely to be payably auriferous. It may be observed that encouraging prospects have lately been obtained from a bore put down in that direction by the Dowling Forest Gold Mining Company.

It is not for a moment intended to be implied that the actual quartz reefs now worked at Clunes continue as the same reefs for many miles, unbroken and auriferous, but that the belt of strata which contains them is persistent in both directions, and is likely to contain successive "makes" and "shoots" of auriferous quartz, from the denuded portions of which the adjacent leads have derived their supplies of alluvial gold.

The northern course of the Clunes belt is also for a number of miles hidden by basalt, and its actual bearing is uncertain, but, assuming it to have the normal strike observable in the rocks of exposed Silurian country on either side, its continuation bears straight for the Majorca gold-field.

There has been much fruitless expenditure within several miles north from Clunes in endeavouring to trace the reefs in that direction, and it may be either that a barren or poor interval occurs, or that the trials made have not been on the actual line of continuation of the Clunes strata. The surer test would be to ascertain, by boring on, or slightly eastward of that line, the position of the deep lead, which must cross from south-west to north-east somewhere between Clunes and the northern Eglinton swamp, and having found the deep ground to sink and test it, for, if payably auriferous anywhere on its course, that is the most probable locality in which to find it so, and the discovery of alluvial gold would be a guide to that of the now concealed reefs. The extension of the Mount Glasgow lead is also most likely to be found payable, where it crosses the strike of the Clunes belt between Mount Cameron and Splitters' Creek.

As to the existence or non-existence, beneath the basalt, of an auriferous belt of Silurian rocks eastward from Clunes, or between the meridian of Clunes and the Spring Hill group, there is as yet no evidence. If such a belt exists or did exist in the denuded and removed strata, good results will probably be obtained from the deep alluvial ground, but if there are, or were, no auriferous matrices in the Silurian rock between the two localities, it is not to be expected that the leads will prove rich. It must be remembered, however, that the amount of Silurian bed-rock, with its contained quartz reefs, that has been denuded within the Loddon watershed, and of which the gravels beneath the basalt are the residue, may be estimated in *cubic miles*, and there is no knowing what auriferous veins may have been contained in so vast an amount of material, even though the unremoved bed-rock be deficient.

It would, however, be advisable, before undertaking expensive mining works in the country lying from 1 to 3 miles east from Clunes, to await the developments of the Lothair lead north-eastward, and the Berry and Australasian leads north-westward on their respective trends.

Every additional foot that payable wash is found to extend eastward from the meridian of Clunes, or westward from that of the Madame Berry mine, may be taken

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as an indication that other washes on, or adjacent to, a line north and south from such point, will be also payable.

The subjoined diagram (No. 5) illustrates this theory. (See page 42.)

Nothing of a payable character appears to have been found in any shallow ground for some distance westward from the meridian of Clunes, the nearest known belt of auriferous country in that direction, being a narrow one extending south from Mount Glasgow nearly along the divide between the Deep Creek and McCallum's Creek. A line of quartz reef was proved auriferous and worked here many years ago, but it has for a long time been abandoned.

A number of gullies have been worked from their heads for short distances westerly from this line of reef, and the Mount Glasgow lead running north-easterly also starts from it.

On its extension northward from Mount Glasgow several reefs, now abandoned, have been worked in past times, and in some cases, it is stated, with rich results.

This narrow belt of auriferous country has not yet been traced far to the south, but it appears likely that careful prospecting along its course would be successful.

Its southward production would be crossed, rather to the eastward of the railway line, by the lead already described as formed by the combination of the two that skirt Mount Beckworth range, and its further continuation would be adjacent to, and parallel with, the easternmost of those two leads, and also in the direction of the volcanic hill previously referred to, on which a nugget is stated to have been ploughed up.

Westward of the Mount Glasgow auriferous belt is a strip of rangy Silurian country a mile and a half wide, intersected by numerous gullies, and containing many quartz reefs, but which, though much prospected, appears nowhere to have yielded anything approaching a payable quantity of gold.

Next comes another narrow but important and well-defined auriferous belt, which may be described, as a detached eastern portion of the great belt containing the Talbot, Amherst, and Maryborough gold-fields.

The southern workings on this line are in a gully falling into a large creek running into Beckworth Creek, a little eastward of the Clunes and Beckworth parish boundary, and north of the basaltic strip which skirts the north slope of Mount Beckworth and conceals the junction of the Silurian and granite. It is not unlikely that the lead beneath the basalt may contain a remunerative patch eastward of where it crosses the extremity of the auriferous belt, and where the latter abuts on the granite.

Proceeding north along the line, the gullies crossing and adjacent to it have been worked to near the railway line, where a blank and non-auriferous interval seems to occur. North of the railway line, and close to the eastern boundary of the basalt covering the Mount Greenock lead system, a shallow alluvial patch has been worked near Antrim Gully, while on the west side of the gully, and passing under the basalt, are auriferous gravels.

At Dunach, in the vicinity of the same line, the best yields of the Hoffnung and Union mines, on the Mount Greenock leads, were obtained in gravels on comparatively high reef eastward of the actual deep ground of the lead, which is here poor. In the Union mine a quartz reef was struck in the bed-rock, and half-an-ounce of gold per ton obtained from a trial crushing. The continuation of the line extends under Samuel's Plain, to the north of which, and just eastward of the line, the Sadowa mine, on the lead coming from Talbot, was exceedingly rich. Still further northward on the same course, in the Silurian ranges outside the limits of the survey, are the Cockatoo, Blucher's Reef, and Emu workings, and thence a chain of workings extending to Maryborough.

Separated from the last-mentioned narrow auriferous belt by a barren or poor one of about a mile in width, is the wide auriferous belt containing the Talbot and Amherst gold-fields. The shallow workings of this belt terminate southerly at the edge of the basalt covering the Mount Greenock lead system, and to the south of the basalt appears the granite. Northward the belt extends for many miles, in fact to the northern plains beyond Wedderburn.

Though broken in continuity by the granite of the Mount Beckworth ranges and of the Main Divide, and for some distance further covered by basalt, I believe the true southward extension of this belt is to be found in the Haddon and Smythesdale gold-field, and that consequently, the deep ground trending west from Ballarat, is likely to be rich beneath the Burrumbeet Plains where the belt is crossed.

The width of the Talbot and Amherst belt is not less than 4 miles, and its western verge is outside the western limit of the survey.

The Mount Greenock lead heads from the south-west in the direction of Lexton, and passes into the area surveyed on its western side, beneath the basaltic plain lying between McCallum's and Stoney creeks; its general course is north-easterly to Mount Greenock, and thence about north-north-easterly to Majorca, conforming generally to the course of McCallum's Creek, of which it was the ancient equivalent prior to the lava-flows.

So far as the country has been geologically surveyed, the workings on this lead are confined to the vicinity of Mount Greenock, though a considerable amount of work has been done along its course beyond the northern boundary of the area towards Majorca.

From the Rip Van Winkle workings (now abandoned) beneath Samuel's Plain, it appears that yields were obtained which, in the opinion of many, would have given profits under a more economical system of working than was adopted. The Union Extended mine was also abandoned, for, although some good gold was obtained on high reef eastward of the shaft, the energies of the company were exhausted in testing the deep ground to the westward, which proved unremunerative.

It would appear that in many cases the application of Ballarat experience to mining on this lead has proved prejudicial to its successful development, as those accustomed to find the best of the gold concentrated in the deeper portions of the Ballarat gutters, were discouraged, on finding the deep ground of the Mount Greenock lead to be poor, and, giving up hope, they did not properly test the reef-washes on the slopes above the gutter-level. This work has lately been carried on with good results by the Union Company.

The poverty of the deep ground, and the better quality of the eastern reef-wash at Mount Greenock, appear to be due to the position there of the lead with respect to the above described narrow detached auriferous belt, and the adjacent strip of poor strata on the west thereof. The auriferous belt comes within the eastern margin of the Mount Greenock lead-channel near Dunach, and the deep ground of the lead lies over the poor belt, at any rate, as far as abreast of the Union Extended shaft; but northward from there the trend of the lead, and the strike of the auriferous belt, must cross one another diagonally, and should the latter there maintain its character, there should be some good ground under the plain on a line from Mount Greenock towards the Sadowa.

In fact, it may safely be predicted, that either the deep ground, or the reef-washes, between the parallels of the Union Extended and Rip Van Winkle shafts, will eventually be profitably worked.

Up the course of the lead, or south-west from Mount Greenock, the Nichol's Freehold Company failed to make the deep ground pay, though gold was found more or less all through it. The property, however, is situated exactly on the poor belt of country, and the best gold obtained was to the eastward and evidently derived from the narrow auriferous belt which supplied the gold in the Hoffnung and Union mines.

The South Greenock Company's workings are still further south-west, and, though on the western edge of the poor tract, are immediately below the eastern margin of the great Talbot and Amherst auriferous belt, and the general yields show a marked improvement on those obtained in the Nichol's Freehold. Until lately no defined gutter, nor a wash resembling a true gutter-wash, had been discovered. The workings, during a long period, revealed a wide extent of angular and partly water-worn gravel, ferruginous cement, and fine sandy gravel, lying on a slightly undulating bed-rock having no defined channel. The limits within which this wash contains gold are as yet unproved, and the gold itself is a very excellent sample, including nuggets up to two ounces in weight, but is patchy in its occurrence and not concentrated in a defined "run." Latterly, however, a tolerably well-defined gutter, carrying a heavy wash, with a more evenly distributed and larger

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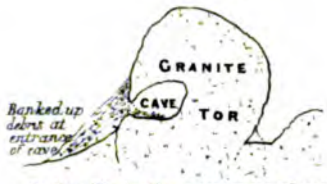
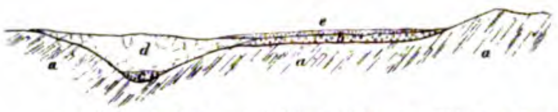
FIG. 1.



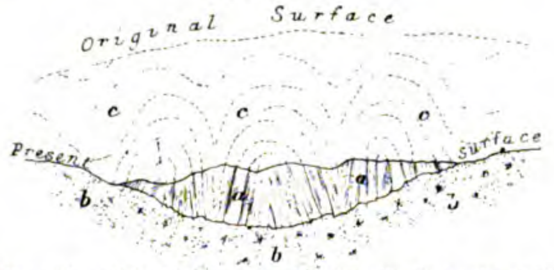
Section illustrating occurrence of concealed cave in a granite "Tor."

FIG. 2.



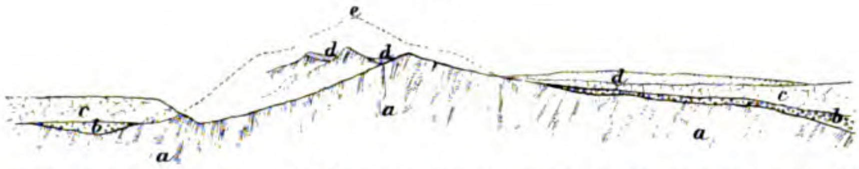
a Silurian bed-rock. *b* "Oldest" drift. *c* "Older" or lead-drift. *d* Basalt. *e* Thin covering of "Recent" deposits.

FIG. 3.



Section illustrating the folding of the Silurian rocks, the absorption by granite of their lower edges, and the removal by denudation of their upper folds. *a* Remaining Silurian rocks. *b* Lower edges absorbed and transmuted into granite. *c* Upper folds removed by denudation.

FIG. 4.



Sketch section illustrating differences in physical structure resulting from varying geological conditions on the slopes of the range separating the McCallum's Creek and Deep Creek drainage areas. *a* Silurian bed-rock. *b* "Older" drift of leads. *c* Basalt. *d* "Recent" deposits. *e* Former position of dividing ridge.

FIG. 5.

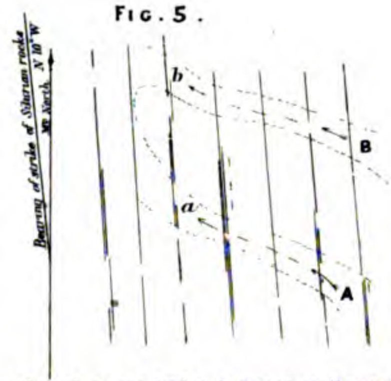


Diagram illustrating the theory that where one lead A is proved auriferous to any point *(a)*, another lead B is likely to be auriferous to a point *(b)* on the line of strike from *a*.

quantity of gold, has been discovered to the eastward, and is now being developed. At present the yields are sufficient to cover working expenses; but as the ground is opened up, and a larger quantity of dirt can be washed, it is probable that the mine will become a paying one, and also that the south-western ground nearer the auriferous belt will be richer than that near the shaft.

The general appearances suggest the idea that the mine is situated below the confluence of several leads, one or two of which may be rich above that junction, but that below it, the average of gold in the wash has been reduced by the contributions of poor gravel from the other leads, one at least of which comes in from the south, and has derived its wash partly from granite, and partly from a poorly auriferous tract of Silurian country. It is also likely that in the neighbourhood of the South Greenock mine there is a confluence of two main branches of the lead, one of which corresponds to McCallum's, the other to Stoney Creek. Much of the material in the former must also have been derived from granite and from the junction of that with the Silurian rocks.

These two leads (if there are two) lie within a mile of one another as far as the western boundary of the survey, but whether there be two leads or only one, I consider that the up-stream untried portion of the lead-system, for at least 3 miles south-westward from the South Greenock mine, is likely to be found richer than any part worked below, because for that distance the lead or leads pass over the southern end of the Talbot and Amherst belt, and the shallow gullies in the Silurian ranges immediately north of that portion of the lead are nearly all auriferous, some having been of great richness and yielded nuggets of large size.

The continuations of the lines of strike of a number of auriferous reefs, including the Union Reef at Amherst, all bear towards the portion of the lead referred to.

It is true that the ranges to the south of the lead are granite, but the Silurian rock shows beneath the southern edge of the basalt along McCallum's Creek, proving that the bed-rock of the lead, or leads, is Silurian rock from side to side, at any rate, for the distance over which they traverse the end of the auriferous belt. I would therefore confidently express the opinion that the untested properties south-westward from the South Greenock mine—known as the Greenock Railway, the Nichol's Estate, and Adams' Freehold—are likely to be payably auriferous, especially the last, which is on the strike of the richest part of the auriferous belt. Rich shallow ground has been worked to its north-west corner, and also at various places close to its northern boundary as far as where the Silurian rock dips beneath the basalt.

The testing of these properties will offer but few difficulties, as the depth of sinking does not exceed 150 feet, and the water, though heavy, is by no means excessive or unmanageable in quantity.

QUARTZ WORKINGS.

The reefs of Clunes have already been generally described in a report by Mr. Norman Taylor, published in Geological Progress Report No. V.

The workings on these reefs, from which so many tons of gold have been obtained, lie within a total length, on the bearing of the reefs, of about a mile and a half, and various efforts to prove their future continuation in either direction have so far proved failures. Reasoning, however, from experience of other districts, it seems altogether unlikely that the short length mentioned comprises the only auriferous portion of the belt. The actual quartz reefs themselves of Clunes may terminate, but the group of Silurian strata which contain them continue, and are likely to contain other reefs. Though so little is known of the causes which operated in effecting the modes and degrees of distribution of gold in quartz, one general conclusion derived from mining experience throughout the world is, that mineral veins in certain bands or groups of bands in the Palæozoic rocks are metalliferous, while in other parallel, adjacent, and apparently similar groups, the veins, though present, are deficient or poor in metals; also that the metalliferous character of a group of strata, though broken occasionally by barren intervals, continues, as a rule, to accompany them in their direction of strike, whatever the bearing thereof, so far as the bands themselves extend; and that consequently, when auriferous reefs are found at any place, other "makes" are likely to be found on the continuation in strike either way of the rocks which contain them, and this rule applies even to cases where the veins cross the strata.

Thus in the diagram (Fig. 6) there are represented two belts of strata containing metalliferous veins, and separated by a belt in which the veins are barren.

In one (A), the veins run with, and in the other (C) they cross the strata; but in the case of C, as well as of A, there would be greater likelihood of making further valuable discoveries by following in either direction the strike of the containing strata in search of other veins than by following the courses of the known veins into the barren belts.

The continuation either way of the Clunes belt is for a long distance concealed by basalt, and consequently the tracing of it is attended with special difficulty, as, even though the bearing of strike within exposed limits be accurately known, there is no guarantee that that bearing continues without deviation, or that "faults" may not exist which throw portions of the barren into the course of the auriferous bands, and *vice versâ.*

In one mine alone, northward of Clunes, it is stated that £80,000 were expended in searching for the continuation of the reefs, and that, though quartz was found in large quantity, not an ounce of gold was obtained from it.

One-fourth of the above expenditure would amply suffice to test the deep alluvial ground already indicated as crossing the course of the belt between Clunes and the northern Eglinton swamp. Were that found non-auriferous, then it might be concluded that there exists an actual break of continuity in the auriferous character of the belt; but, on the other hand, the discovery of payable alluvial gold, would prove the proximity of auriferous quartz, to the exact locality of which the mode of distribution of the alluvial gold would serve as a valuable guide. By this means also, the presence of auriferous veins (if any) on either side of those known would become manifest. The foregoing remarks apply equally to prospecting operations on the southern extension of the Clunes belt.

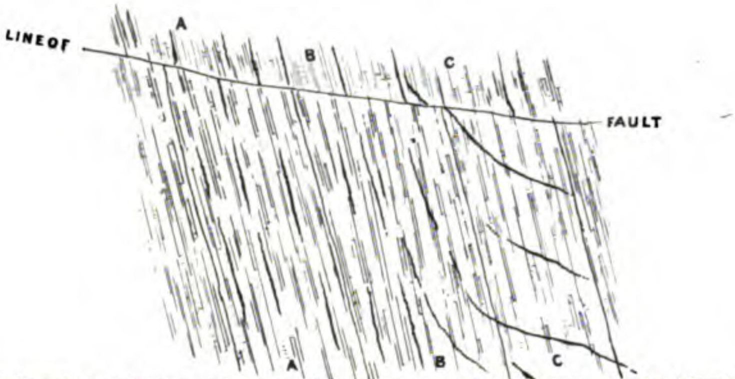
The reef south from Mount Glasgow is the next known auriferous reef westward of the meridian of Clunes, and though stated to have yielded poorly, the "makes" of quartz are of considerable size, and the locality is certainly one in which further trial is advisable. Between the Mount Glasgow Reef and McCallum's Creek there are many outcrops of large and persistent quartz reefs, but the absence of payable gold in the well-prospected gullies crossing them seems to forbid the hope that they are likely to prove remuneratively auriferous.

The narrow auriferous belt described as passing near Dunach is one in which quartz prospecting is likely to prove successful, both in the exposed Silurian country to the south, and also beneath the basalt from Dunach to the Sadowa. The position of the auriferous reef found in the Union workings at Mount Greenock, and which yielded half-an-ounce of gold per ton on a trial crushing, is such, that it could not be advantageously worked without first incurring a considerable preliminary expenditure in order to obtain command of it; but, it is to be hoped, that its proper exploration, at some future time, will not be neglected.

In the ranges on the Talbot and Amherst auriferous belt, in the north-west portion of the area geologically surveyed, there are many quartz reefs, some few of which are now being worked, the principal being the New Reef, Nuggety Gully, the All Nations Reef, and Potter's Reef. A number more have been partially worked and abandoned, while the greater number are practically untried.

The general experience gained by working the reefs in this part is stated to be that the quartz reefs are "blocky" (*i.e.*, making in blocks, which run to nothing on their strike, and also downwards), and that the gold contained in them is "patchy," and a common story in connexion with the reefs partly worked and abandoned during the early days of the gold-field is that they were good from the surface down to the water-level, and either became poor there or else, the proprietors having spent their earnings, had no capital wherewith to erect machinery. Not a single reef within the north-west corner of the block surveyed appears to have been tested as deep as 200 feet, and in one or two cases a lamentable want of enterprise has been shown. For instance, it appears that on the All Nations Reef, 3 miles S.W. from Talbot, two shoots of stone were in the early days worked down to about

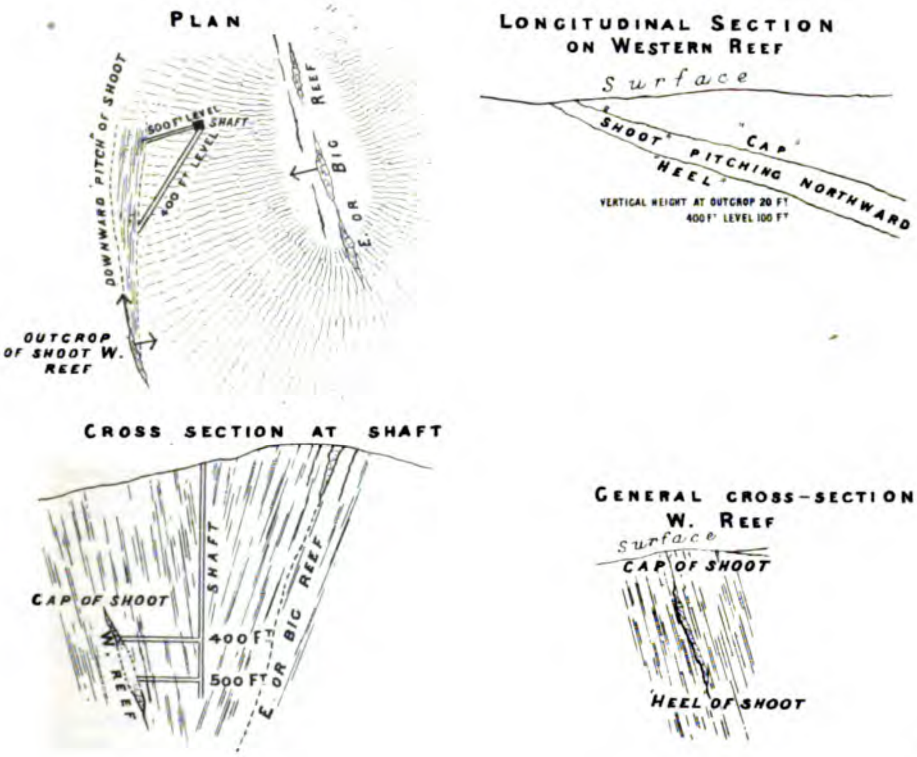
FIG. 6.



Ideal plan of alternate metalliferous and non-metalliferous groups or belts of strata, showing lateral faulting. A Metalliferous belt with veins in same direction as strata. B Non-metalliferous belt of similar strata containing veins, but not metalliferous. C metalliferous belt with veins crossing strata.

Fig. 7.

Plans & sections illustrating occurrence of reefs, Union G.M.C° Amherst.



100 feet from surface. On the northern shoot, stone yielding as high as one ounce, and on the southern a general average of half-an-ounce of gold per ton, is stated on good authority, to have been obtained. A company, formed to work the reef, sunk a shaft between the two shoots to a depth of 169 feet, broke into the old northern workings, and obtained trial crushings, poor, but sufficient to warrant a further trial. A pumping, winding, and crushing plant was purchased, erected, and got to work, but after a little "fossicking," and some poor crushings of remaining available stone in the northern workings, the company gave up, when another 50 feet of easy driving would have brought them to the southern shoot, and an expenditure of £500, or three calls of 2d. each on the capital, would have enabled another 100 feet to have been sunk, and both shoots tested from that level.

Though outside the block surveyed, the reefs worked by the Union Company at Amherst are worthy of notice. There are in the claim two reefs, the western and the eastern, or big reef.

The eastern is simply a "shoot" of auriferous quartz, tapering out to nothing at top and bottom, having a downward dip or "pitch" to the northward, and an easterly underlie. The vertical height from "cap" to "heel" appears to increase as the reef is followed on its dip, for where found near the surface it was only 20 feet, while at the 400-foot level it is about 100 feet.

The thickness varies from a few inches to 3 feet, and the yields from the reef have been good throughout, reaching in some instances to as much as 10 oz. per ton. This shoot of stone appears likely to continue to great depths. The eastern, or "big reef," consists of wedge-like blocks of stone, pitching northerly, but thinning out as followed down, and having a westerly underlay. A continuous vein is, however, being traced downwards, and some good prospects have been obtained from it. The sketch plan and sections (Fig. 7) will convey a general idea of the modes of occurrence of these reefs. It is noticeable that on the strike of these reefs southward for several miles, to the very edge of the basalt near Stoney Creek, and also on the lines of continuation of the All Nations, the New Reef, and several lines that have not been worked, the alluvial deposits in the gullies and flats have been rich in gold, indicating that there are many "makes" of gold-bearing quartz other than have yet been discovered. Whatever failures may have been, or yet may be encountered, there are good grounds for the opinion that quartz mining in the ranges west and south-west from Talbot has a prosperous future in store, if only a fair amount of patiently and intelligently directed enterprise be bestowed upon it.

In the reefs near Talbot there is a scarcity of minerals other than iron pyrites, and occasionally a litte galena. Native copper was found in a quartz vein near the dyke intersected in the workings of the Hoffnung Company at Mount Greenock.

The following list of minerals occurring in reefs at Clunes occurs in Mr. Norman Taylor's notes :—

In Reefs.

Pharmacosiderite Bendantite ... Scorodite ...	Arsenical iron, Port Phillip Company's mine.
Diallogite ... Rodocrosite ...	Carbonate of manganese, Port Phillip Company's mine.
Psilomelaine ...	Oxide of manganese, Port Phillip Company's mine.
Spathic iron ...	Carbonate of iron.
Brown spar ...	Carbonate of iron and lime.
Epsomite ...	Sulphate of magnesia, Port Phillip mine.
Calcite	Carbonate of lime.
Prase	Green quartz.
Zincblende ...	Sulphide of zinc.
Iron pyrites ...	Bournonite, antimony, and gold in quartz, New North Clunes mine.

In Drifts.

Bismuthite ...	Carbonate of bismuth, enclosing gold.
Zircon	
Native copper ...	Clunes Company and New Lothair.
Stibnite	

REGINALD A. F. MURRAY,
Geological Surveyor.

Talbot, July 17th, 1883.

ADDENDA.

I.

With reference to the tracts of country that have been well prospected and found non-auriferous, I may with propriety renew the suggestion made ten years ago in my report on the Ballarat gold-field, that these areas be utilized as forest reserves, not merely by proclaiming them as such, but by also causing proper supervision to be exercised for the protection of young timber growing naturally, for the elimination of useless growths, and for the planting of seedlings where requisite.

The non-auriferous tract of Silurian ranges lying between McCallum's Creek and the ridge extending north and south from Mount Glasgow, is well adapted for the above purpose; it is useless for agriculture, except in the narrow flats of gullies, and of very little value for grazing, but fair timber once grew on it, and would grow again if permitted. There is a plentiful growth of young timber, both suckers and seedlings, including many promising ironbark saplings; but I had ample opportunity, during the survey of the district, of seeing that these were cut indiscriminately by whoever required them, and that the intermittent visitation of the area by the police was altogether insufficient as a check on such destruction.

II.

Among objects of other than geological interest, there are in the area surveyed numerous old ovens of the Aborigines, usually near water, and in the more open country.

They consist of small piles of pieces of basalt—evidently selected on account of its superior heat-retaining properties—mixed with earth and ashes. I do not find any implements or weapons among them, but no doubt such would be found if the ovens were opened and examined.

There are also in several localities in the rangy country small mounds, about a chain in diameter and rising 3 or 4 feet above the natural surface of the ground.

These contain no ashes, but are composed entirely of earth, quartz fragments, and slate rubble, gathered from the surrounding surface.

They are evidently the work of Aborigines, but were not cooking or camping places; they might have been burial places, but Mr. A. W. Howitt, to whom I described them, suggests as a more probable explanation, that they were the scenes of the mysterious initiation ceremonies practised by the Aborigines when admitting young men to the rights of manhood, such as have recently been described with reference to the Queensland blacks in an article by Captain Armit, published in the ***Australasian***, under the title of "a Bora."

III.

The subjoined notes on the microscopic examination of the Granite Hill dyke stones have been kindly furnished by Mr. A. W. Howitt, F.G.S:—

"*Sample* 1 (*large granite dyke*).—The structure of this rock is crystalline granular; the minerals composing it are the following, stated in the order in which they have been formed:—

"(1.) Hornblende.—This mineral occurs in somewhat lengthened prisms and also as fragments of such prisms. The prismatic plane and the clinopinacoids are in some cases well developed, while the terminal planes are absent. The prismatic cleavage of hornblende is well marked, the crystals become translucent in shades of brown, and the sections are strongly polychroic. The absorption is $c>b>a$, and the colours of the three rays in the same order are dark-brown, brown, pale-yellow.

"(2.) Felspars.—These are of two kinds, (*a*) orthoclase in somewhat large but not well crystallized masses; (*b*) plagioclase in smaller crystals, which are much extended in the direction of the edge ü—ŭ; the structure of these felspars is most frequently according to a combination of the albite and carlsbad laws. The extinction-directions indicate a felspar of the oligoclase group standing nearer to albite than

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to andesine, but without a quantitative examination of the rock this must remain uncertain.

"(3.) Crystals of quartz showing prismatic and pyramidal outline and crystalline grains of quartz.

"(4.) Compound crystallizations of quartz and felspar. These are very remarkable; they strongly resemble the structure which has been described by MM. Fonqué and Lévy as 'ophitique,' and which has great resemblance to 'graphic granite.'

"These crystallizations sometimes fill in spaces between the constituents, sometimes form a border surrounding one of the two other minerals. In some cases these alternations of quartz and felspar form fan-shaped aggregates, and in other cases a network in which the net is felspar and the mesh is quartz; these crystallizations represent that which in quartz porphyries is the ground mass, *i.e.*, a more or less crypto-crystalline mixture of quartz and felspar.

"This structure of that part of the rock which represents the ground mass in the allied porphyritic rocks, together with fan-shaped, even radial arrangement of, the quartz and felspar aggregates around a central crystal, places this rock near the granophyrs of Rosenbusch.

"Alteration Products.—The hornblende has suffered two forms of alteration:—(*a*) Certain portions have been converted into a chlorite mineral which is precisely analogous to similar alterations which I have observed elsewhere, *e.g.*, in the quartz-mica diorites of Noyang; the chlorite preserves the form of the hornblende; it is green in colour, and moderately polychroic in shades of metallic green. (*b*) Other parts of the hornblende have been replaced by epidote. This replacement has been far greater in amount than the one just described, and it consists rather of an aggregate of epidote crystals than in one or few. As seen in the thin slice, it is pale-yellow, very faintly dichroic, but polarizes with rich shades of yellow. It precisely resembles similar alterations which I have observed in the above-mentioned Noyang rocks.

"The alteration in the felspars is mainly kaolinization with infiltration of iron ores, and in a less degree the production of micaceous minerals, which may be suspected to be muscovite.

"Magnetite does not seem to have been one of the original minerals, but to have resulted from the alteration of hornblende to chlorite, with the elimination of iron. Ferric hydrate has been largely produced, and I ascribe to it the prevalent red colour of this rock.

"Finally, in certain places in the slice, I observed radial spherulitic masses of some chloritic mineral, evidently one of the alteration products.

"As the majority of the felspars are orthoclase, this may be classed as having been an amphibol granite in its unaltered state; the presence of so much plagioclastic felspar, however, causes it to stand near to the quartz diorites. The alteration products which are so prominent in this sample, might not be found so in samples collected beneath the surface, and do not, it seems to me, justify the constitution of a new species of rock.

"The granophyric character of some parts of this rock remove it to a position in the amphibol granite series, where it would approach to the porphyritic members.

"*A second sample* proved on examination to be a rock of the same kind, the difference being that, while in the one I have described, the alterations of the hornblende were mainly into epidote, those in this sample were to chlorite.

"*A third sample* I found so much altered that it was difficult to assign its proper position. I think it may be classed as being a porphyritic example of a quartz diorite., *i.e.*, having a ground mass of small plagioclase crystals and quartz with porphyritic crystals of amphibol, felspar, and quartz. The first of the three has been converted to chlorite, the second almost wholly to kaolin. This rock may be described as a quartz porphyrite."

REGINALD A. F. MURRAY,
Geological Surveyor.

Talbot, 24th July, 1883.

RODBOROUGH GEOLOGICAL SURVEY.

Geological Surveyor's Report.

The area represented by the Rodborough Geological Map is nearly 63½ square miles, and lies between meridians 143° 50′ and 144°, and between parallels 37° 6′ and 37° 12′, its length east and west being about 9 miles 15 chains, and its breadth north and south 6 miles 71 chains.

It is joined on the north and south respectively by the Moolort and Glengower geological surveys carried out under the direction of Mr. A. R. C. Selwyn, formerly Government Geologist.

The Deep or Tullaroop Creek runs through the area from south to north within the western margin, and Joyce's Creek similarly traverses the eastern portion. The Middle Creek, tributary to Joyce's Creek, runs from S.S.W. to N.N.E. diagonally across the central portion of the area.

The tract lying between the Deep Creek and Joyce's Creek consists of open basaltic plains, and gently undulating country, terminating in abrupt escarpments, and steep banks at the verges of the slopes towards the two larger creeks, and sloping less abruptly towards the Middle Creek, which traverses the central portion of the tract.

Eastward of the alluvial flats bordering Joyce's Creek, the country included in the survey, consists of broken Silurian ranges ; westward of the Deep Creek it is partly basaltic plateau, and partly Silurian and granite ranges.

The geological formations are as follow :—

Alluvial.

Deposits in creek flats, gullies, and swamps.

Post-Tertiary.

Recent.

Clays, gravels, ferruginous deposits, and beds of infusorial earth, older than the alluvial deposits, but more recent than the volcanic layers.

Tertiary.

Newer Volcanic.

Basalt, lava, scoria, volcanic-ash, &c., of the plains and plateaux.

Upper Pliocene clays, sands, gravels, and conglomerates of the deep-lead deposits beneath the volcanic layers.

Lower Pliocene gravels and conglomerates older than the drifts of the deep leads.

Palæozoic.

Lower Silurian.

Slates, shales, sandstones, and granite.

Granite.

Between the western boundary of the sheet and the Deep Creek there is a small exposed area of granite, being a portion of an isolated tract a few square miles in extent lying between the Deep Creek and Majorca.

The north and south margins of this granitic area converge in the vicinity of the Deep Creek, eastward of which the granite passes under the basaltic plains, but from general indications does not appear to extend far.

In character the granite is from fine to coarse-grained, of the ordinary ternary kind, and it is traversed by dykes of finer grained, sometimes porphyritic varieties.

Lower Silurian.

The Lower Silurian rocks of this district do not present any special features differing from those of other localities ; the ordinary varieties of slate, shale, and sandstone being the prevailing forms.

The usual indications of contact metamorphism appear, where the Silurian rocks are visible near their junction with the granite.

UPPER AND MIDDLE PLIOCENE.

Exposed gravel and cement deposits of Pliocene age are found resting as cappings on the Palæozoic rocks constituting the ranges at either extremity of the sheet. At the eastern end they consist of quartz gravels and ferruginous cement layers, which flank the slopes into several large gullies tributary to Joyce's Creek. They appear to pass under the alluvial flats bordering the creek, and thence beneath the basalt to join the deep leads under the plains. From their position low down on the slopes and their general character, these gravels and conglomerates east of Joyce's Creek appear to be of contemporaneous origin with the drifts of the deep leads, and are therefore classified here and described on the geological map as Upper Pliocene.

Clay, sandy drift, black clay approaching lignite in character, and gravel, have been proved to exist beneath the basalt of the plains by means of the bores put down by the Bucknall's Estate Gold Mining Company.

In the western portion of the sheet, the exposed Pliocene deposits consist almost entirely of beds of a somewhat curious cement, resting principally on the granite and passing under the basalt on either side of the Deep Creek. In some places it forms cappings on granite rises, as well as occupying low-lying slopes. This cement appears to be composed entirely of fine water-worn granitic detritus, full of round, or oval ironstone nodules, which do not appear to be rolled fragments, but concretions which have formed themselves in the cement since its deposit.

On account of the general mode of occurrence of this cement, it has been provisionally classed as referable to the Lower Pliocene period, or older than the deposits of the deep leads.

VOLCANIC.

The basalt generally throughout the area is of the normal character, and includes the usual varieties. Beds of volcanic ash occur on the eastern slope of Grant's Hill, the only extinct point of eruption within the limits of the sheet. Two distinct layers of basalt have been passed through in the Nos. 7, 9, and 10 bores put down by the Bucknall's Estate G. M. Co.

POST-TERTIARY.

Among the Post-Tertiary deposits the only ones of interest are those of infusorial earth, which occur near the Middle and Deep creeks.

In the first-named locality, the infusorial earth lies beneath the surface soil and clay, along the eastern slope towards the creek in Mr. F. Bucknall's home paddock.

It was found in sinking for a well or tank, and was at first supposed to be pipe-clay "bottom," until further sinking disclosed the fact of its resting on basalt.

The extent of the bed is uncertain, and from what can be seen of the material it appears inferior in quality for dynamite manufacture to that obtained from the Doctor's Creek, west of Amherst, but it is no doubt of economic value, and might be found in places to be of as good quality as any known.

Of the other deposits, only trifling exposures are visible from beneath the surface soil on the steep banks on either side of the Deep Creek, midway between the creek and the edge of the plateau, south-easterly from Grant's Hill. The deposit has not been at all explored, but it appears to be a layer between two sheets of basalt, occurring, as it does, at the same elevation on either bank of the creek. It may, however, be only a superficial deposit which has been cut through by the creek, leaving a vestige on either bank. This earth also appears to be of economic value. In the same locality there is a good deal of impure opal and some blocks of siliceous rock, apparently indurations by further silicification of the infusorial earth.

Among the thin coverings of recent deposits on the basalt, are some of a ferruginous character, containing much pisolitic iron-ore, and others containing numerous large and small nodules of lime. North of the Splitters' Creek, in clays resting on both basaltic and Silurian rocks, near the junction of the two formations, masses of lime occur in sufficient quantity to be used for lime-burning ; the lime is said to be of very good quality, and to yield an excellent cement.

General Observations.

Geologically, there is nothing of special interest in the area represented by the Rodborough Geological Sheet differing from the phenomena observable in the adjacent surrounding district. The observations in the preceding papers on the deep leads of the Loddon Valley and on the Clunes and Mount Greenock district, as to the geological history of the country, apply equally to that under notice.

The main conditions are:—1. A great trough in the Palæozoic rock-foundation, of which the exposed granite and Silurian rocks on the east and west of the plains constitute the sides. 2. Sedimentary and detrital deposits, lead-gravels, &c., of Pliocene age, occupying the channels and low-lying slopes of the trough. 3. Volcanic layers poured out from the points of eruption to the south, partially filling the trough from side to side, and for the most part covering and concealing the Pliocene deposits. 4. Creek channels eroded, and deposits formed therein, on either side along the lines of junction of the volcanic and Palæozoic rocks, and also through the central portion of the volcanic area.

From a practical point of view, as the probable future scene of extensive alluvial gold-mining operations, and possibly quartz mining as well, the area under notice is of special interest, containing, as it does, some 7 miles in length on the course of the continuation of the combined leads of Hepburn, Kingston, Smeaton, Creswick, and Clunes. On the geological map are shown the bores put down by the Bucknall's Estate Gold Mining Company, who have conducted their operations in a systematic manner, commencing on the west near the Deep Creek, and boring at regular intervals on an easterly line across the plains.

The accompanying section shows the information obtained by means of these bores, of which the last one bottomed (No. 10), on the east bank of the Middle Creek, south-west from Mr. F. Bucknall's Homestead, reached the bed-rock at 348 feet, after passing through two thick and distinct layers of basalt and various clays and drifts. The depth named and the surface levels taken for the company by Mr. Robert Allan, Mining Surveyor, show a fall, from the gutter-level at the Madame Berry mine to the bottom of the bore, of over 40 feet to the mile, so that, if not actually on the deepest ground, the bore must be in the immediate vicinity thereof.

As to the probable auriferous character of the main trunk lead and its tributaries beneath the Rodborough Plains, views have already been expressed in the paper on the Deep Leads of the Loddon Valley. That such a main trunk lead exists, and that it is the combined continuation of all the Kingston, Creswick, and Clunes leads, are facts beyond all possibility of doubt; but I altogether disregard these facts as evidence of the probable gold-bearing character of the deep ground.

Special importance is, however, to be attached to the circumstance that the bed-rock beneath the Rodborough Plain is a continuation of the same belt of Silurian rocks as that on which, to the southward, the Ballarat and Creswick gold-fields are situated, and which proved continuously auriferous from Durham to the Madame Berry, while the next surface exposure to the north, on the same direction of strike, contains the Tarnagulla gold-field.

It may reasonably be inferred that this belt of Silurian rocks is likely to maintain its auriferous character throughout the concealed, and as yet unexplored, intermediate portion of its length that lies beneath the Rodborough Plains.

If this be the case, the detrital deposits, or the leads resting on that bed-rock, will assuredly be found to partake of the same character, having had local sources of gold supply all along their courses during the erosion of their channels.

The poorly auriferous character of the exposed Silurian country immediately adjacent on the eastern and western edges of the plains, in no way tends to weaken the above theory, for we find exactly similar belts of poor or non-auriferous character on either side of the auriferous zone of Ballarat and Creswick further to the south. There is no doubt but that the difficulties of exploring and mining the deep alluvial ground in the Rodborough country will be very great, on account of the heavy water and loose drifts that will have to be encountered, but, so far, there

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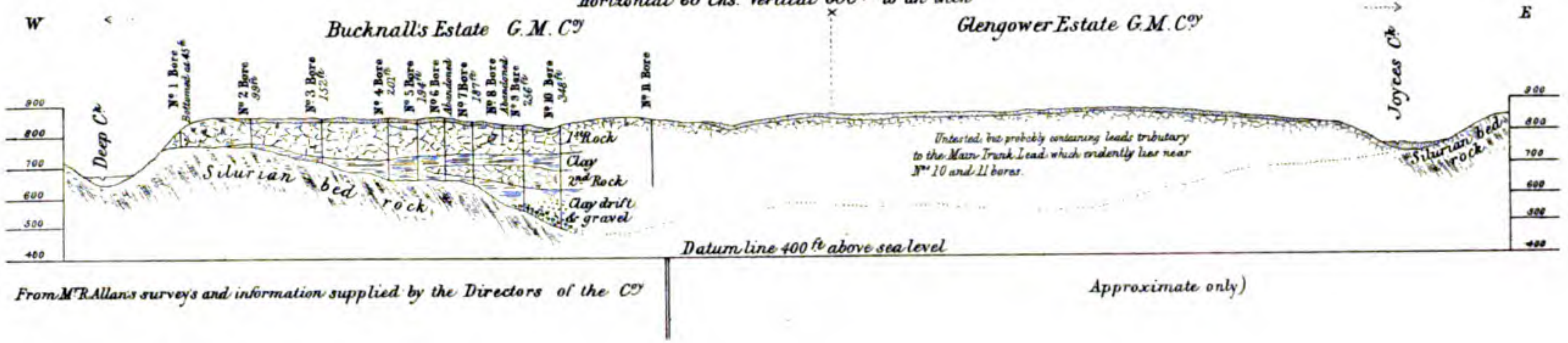
SECTION

(Looking North)

From the Deep or Tullaroop Ck across the Rodborough Plains to Joyce's Ck including the line of bores put down by the Bucknall's Estate G.M.Coy

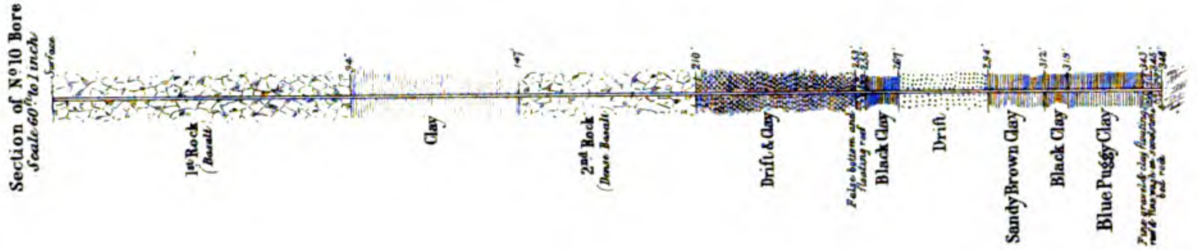
Scale

Horizontal 60 Chs. Vertical 600 ft to an inch



From Mr R. Allan's surveys and information supplied by the Directors of the Coy

Approximate only)



Section of No 10 Bore
Scale 60 ft to 1 inch

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is nothing to show that these difficulties are likely to be greater than what have been successfully combated in other districts.

The general geological testimony, coupled with the actual results obtained in the country north and south, justify the belief that, beneath the Rodborough Plains, will be found valuable and durable sources of gold supply.

To my report on the Clunes and Mount Greenock district is attached an Appendix as to the utilization of the known non- auriferous tracts of Silurian ranges for purposes of forest conservation.

The remarks in that Appendix can be applied with equal propriety to the unalienated portion of the non-auriferous ranges eastward of Joyce's Creek, where a good deal of prospecting has evidently been executed without any valuable results, but where good timber once grew, and would grow again were the saplings protected from indiscriminate spoliation.

REGINALD A. F. MURRAY,
Geological Surveyor.

Talbot, December 26th, 1883.

BACCHUS MARSH DISTRICT.

Geological Surveyor's Report.

Sir, Camp-street, Talbot, August 2nd, 1883.

In accordance with your instructions, I have the honour herewith to submit my report on the geology and mining resources of the country around Bacchus Marsh.

Having assisted the late Mr. R. Daintree, and Mr. C. S. Wilkinson in making the geological and topographical surveys of the district, and being therefore well acquainted with its leading features, it was only necessary to devote a short time to obtain additional information, and to refresh my memory as to the features of a few localities.

The published maps and notes compiled by Messrs Daintree and Wilkinson, leave little to be added in the way of geological description; but, a brief account of the leading features, is a necessary preliminary, to the discussion of the mining resources of the district.

Geological Features.—Silurian Rocks.

With the exception of a limited area of exposed granite near Ingliston, 6 miles north-westward of Bacchus Marsh, the rock-foundation of the whole district consists of Lower Palæozoic Silurian rocks—slates, shales, and sandstones.

These constitute the ranges bordering the Lerderderg River, from the Main Divide down to near Bacchus Marsh; the ranges east of the Bullengarook Plain, also spurs from the Main Divide, and the Brisbane ranges 10 miles south-west from Bacchus Marsh. The Silurian rocks are also exposed in natural section in creeks between Bacchus Marsh and Melton.

Graptolites, the characteristic fossils of these rocks, have been found at various localities indicated on the geological maps.

Mesozoic Rocks.

Flanking the extremity of the Silurian ranges of the Lerderderg, and extending from westward of the Werribee gorge to the lower portion of Goodman's Creek, are thick-bedded sandstones, shales, and mudstone conglomerates, classed on the geological maps as Upper Palæozoic, but regarded by Professor McCoy, on the evidence of the few fossil-plant impressions found in them, as of Triassic, or Lower Mesozoic aspect. These fossils consist of several species of *Gangamopteris*, and are of the fern family. They are figured and described in Professor McCoy's *Prodromus of Victorian Palæontology,* Decade No. II.

To this rock-group belong the sandstones of the Bald Hill and Goodman's Creek quarries, whence the stone for the old Treasury and other buildings in Melbourne was obtained.

The extent of these rocks southward is unknown, as they pass beneath the widely spread Tertiary and volcanic layers of the plains. They are traceable up the Werribee and Pyke's Creek, to Greendale, and appear, where exposed, to be the northern margins of the deposits in a great indentation which, during the Upper Palæozoic and Lower Mesozoic periods, was submerged to a much greater distance inland than the present corresponding indentation of Port Phillip.

TERTIARY DEPOSITS.

Flanking, and filling depressions in the Silurian and Mesozoic rocks, are the deposits of two epochs of the Tertiary era:—1, Miocene, or Middle Tertiary ; 2, Pliocene, or Upper Tertiary.

The Miocene beds consist principally of clays and soft shales, with some ferruginous sandstone and conglomerates, and include also some layers of igneous origin, classed on the geological maps as Older Volcanic. Their mode of occurrence indicates the existence during their deposit, as in the case of the Mesozoic rocks, of a great indentation, from which one arm, or a frith, extended north-westerly between the Brisbane ranges and the Werribee gorge up to Ballan, another to a short distance north of Bacchus Marsh, between the Lerderderg and the Coimadai, and a third beneath the Melton and Keilor Plains, towards Sunbury and the Gap. The portals, so to speak, of this great gulf of the Miocene and Mesozoic epochs are represented by the granite of Station Peak on the west, and on the east by the Silurian rocks of Melbourne, and the Saltwater River.

The fossil-plant impressions found in the ferruginous Miocene beds westward of Bacchus Marsh are figured by Professor McCoy, in his *Prodromus*, Decade IV., and described as consisting principally of leaves of lauraceous plants, differing from the living forms of Australian vegetation, but resembling those of tropical and subtropical Asiatic localities.

The Pliocene or Upper Tertiary clays, sands, gravels, and conglomerates, in places overlie the Miocene layers, but northward of the margin of the latter they are confined within narrower lateral limits, and rest directly on the Silurian bed-rock. The gravel and cement deposits beneath the Bullengarook plateau are of this class, and are, in every respect, geologically analogous to those lead-gravels of Ballarat, Daylesford, and other gold-fields which occupy a position above the level of existing water-courses. The skull of an extinct species of wombat, which was given to me, was stated to have been found in mining in these gravels.

VOLCANIC.

Covering for the most part the Miocene and Pliocene deposits, and marking the close of the Tertiary era, are the newer volcanic layers of the plains, which were poured forth as lava-flows from numerous volcanoes, and overspread all the valleys and basins between the more prominent ranges of Silurian and Mesozoic rocks.

I remember twenty years ago, in company with Mr. C. S. Wilkinson, to have found on the summit of Mount Mary (an extinct volcano), 10 miles south from Bacchus Marsh, an ejected block of sedimentary rock, containing fossil marine shells, characteristic of the Miocene epoch.

Post-Tertiary action, subsequent to the lava-flows, has eroded the existing rivers and watercourses, cutting through the basalt into, and removing some of it from off the subjacent rocks, forming the alluvial deposits and terrace gravels bordering the creeks and rivers, and shaping the general configuration of the country to its present form.

This recent action is well illustrated in the case of the Bullengarook basaltic plateau, which must once have extended evenly between its boundary ranges, but was subsequently cut along its edges by the creeks on either side. These creeks are now deeply eroded into the Silurian rock to a level below that of the lead or old river-bed, which remains for the most part intact beneath the plateau, and accessible, by means of tunnelling, from the slopes on either side.

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General Geological History.

Whatever the details, the general geological history of the district can be plainly read, and briefly summarized, as follows :—

1. A great basin or gulf in the Palæozoic, granite, and Silurian rocks, having several arms joining the main basin near Bacchus Marsh, and in course of time partly filled by the sandstones, shales, and conglomerates deposited during the Upper Palæozoic and the Mesozoic eras, and made up of the material denuded from pre-existing rocks, the ridges of which latter then rose to a greater altitude than at present, owing simply to the fact that they had not then been deprived of the material which has since been removed from them.

2. A repetition of the above conditions during the Tertiary epoch over nearly the same area; the Tertiary deposit being made up of materials denuded from the granite, Silurian and Mesozoic rocks. During the latter part of the period the southern portion of the area was still submerged, while in the northern terrestrial conditions prevailed, and rivers, such as that of the Bullengarook lead, emptied themselves about the parallel of Bacchus Marsh.

3. The lava-flows covered all low-lying portions of the then land surface, and some of what was yet submerged. The volcanic ash-beds near Mount Mary show stratification, indicating that their materials fell into, and were arranged by water.

4. Terrestial conditions, during which the present watercourses were eroded by fluviatile action, the volcanic layers cut into, and in places partly removed, and the alluvial flats and terrace gravels formed along the watercourses.

It may easily be understood that, though in some places there is a regular succession in vertical section of all the various formations enumerated, in other localities some are absent, and we find, for instance, the most recent alluvial deposits resting directly on the Silurian, or the newer volcanic, on the Mesozoic rocks, &c.

Mineral Resources.

Having so far described the general geological features, the practical questions for consideration in connexion with the mineral wealth of the Bacchus Marsh district are four in number :—1st. The existence in payable quantity of gold. 2nd. Coal. 3rd. The presence of artesian waters. 4th. The value of the building stones.

Gold.

In its geological aspect, the area occupied by exposed Silurian rocks in this district is distinctly auriferous, but the results hitherto obtained tend to show that it does not possess an extensive belt of auriferous quartz reefs, such as would be the necessary condition for a large and permanent gold-field.

Nevertheless, the actual discoveries already made are, in themselves, evidence that further gold-workings may be developed by means of intelligent prospecting.

Payable gold has been found in the river workings of the Werribee gorge from the junction of the Myrniong Creek down to the flats, and I have myself obtained good prospects from the granite bottom of the river-bed as far up as Ingliston.

The Silurian ranges west of the Lerderderg on their slopes towards the Korkuperrimul Creek, appear to contain no remunerative deposits, only one small patch having, to my knowledge, been discovered ; but the bed of the Lerderderg and the terrace gravels on its banks and points have yielded tolerably well down to the flats, and at Darley Bridge, only a mile above Bacchus Marsh, it is stated that some very payable gravel was washed from an exposed ridge of Silurian rock which appears in the river-bed there.

Goodman's Creek, west of the Bullengarook plateau, was rich in places, one point (Golden Point) having yielded a large quantity of gold. Its western tributaries, Jimmy's Creek and Peas and Beans Gully (so named from the character of its gold) were also rich.

East of the Bullengarook plateau a large quantity of gold was obtained from Cockatoo Gully, a tributary of the Coimadai Creek, while in the gravels of the lead beneath the plateau, some fair patches have been obtained, though no continuous run of rich ground has been proved. These gravels have, however, been very imperfectly prospected, and, I believe, that if systematically worked on a large scale, with a good water supply, they would prove payable, if not rich, as they could be worked from tunnels with no expense for winding or pumping machinery.

In reference to further prospecting, several recognised principles have to be borne in view :—

1st. That alluvial gold has been derived from the disintegration of auriferous quartz reefs which were contained in the Silurian rocks, and were worn down and denuded by the geological action of past times.

2nd. That owing to its high specific gravity, no free gold, in pieces of appreciable size, has been conveyed and deposited in payable quantity any great distance from where it was disintegrated from its matrix.

3rd. That certain groups of rock bands in the Silurian strata contain auriferous quartz veins, while in other parallel groups the veins are barren, though the reason of this is unknown, and there are no indications short of the results of actual experiment whereby these respective groups can be recognised.

4th. That when either alluvial or quartz gold is found in association with any particular group of Silurian strata, there is a strong likelihood of other auriferous localities being found in either direction along the bearing of the strike of those strata.

The difficulties of search on the last principle are enhanced by the known tendency of gold to occur in disconnected " shoots," sometimes separated by long intervals of a non-auriferous character.

The general bearing of strike in this district is about magnetic north. One observation in a branch of Goodman's Creek gave N. 4° W.; another, below Darley bridge, N. 8° E., as the bearing of the nearly vertical Silurian strata.

With respect to the alluvial gold-workings above enumerated—viz., the Werribee gorge, the Lerderderg, Jimmy's Creek, Goodman's Creek, and Cockatoo Gully—there is no other conclusion than that, in each case, the gold has been derived from the disintegration of local matrices, and as no two of the localities are on the same line of strike, there must be, within a belt of country 9 miles wide east and west, at least five distinct, though probably narrow groups of rock-layers, which contain, or whose denuded portions once did contain, auriferous matrices.

Only one auriferous quartz reef appears, as yet, to have been found, namely, the Golden Top Reef, situate close to a branch of Goodman's Creek.

The shaft being full of water, the workings could not be inspected, but preparations are being made to erect machinery, and work the reef. Though I failed to find gold in the heap of quartz lying at grass, the stone is of most excellent appearance, being dull-white, with fine and frequent lead-blue laminations, and resembling some of the best auriferous quartz of the leading gold-fields. Though some distance apart, the Golden Top and Golden Point workings, on Goodman's Creek, are about on the same line of strike, and it is likely that the line of reef may be found auriferous at various localities between the two places, and that a good shoot of auriferous quartz may be found in proximity to the last named.

Auriferous reefs are also very likely to be found at the Jimmy's Creek workings, and in the vicinity of Cockatoo Gully.

In further alluvial prospecting, attention might be mainly directed to the Bullengarook plain. The northern extension of the belt of Silurian rocks and contained quartz reefs, at the head of Cockatoo Gully, passes under the Bullengarook plain, and the gravels between the basalt and the bed-rock ought there to be well tested. In fact the northern portion of the plateau appears likely to be underlaid by several branch leads, which could be explored by means of tunnelling under the plateau from near the head of Cockatoo Gully, or from any of the numerous convenient sites on the slope towards Goodman's Creek.

As to the southern continuation of the Bullengarook lead, it appears that about eastward of the Goodman's Creek quarries, the Pliocene gravel of the lead will no longer be found to rest on the Silurian, but on a Mesozoic bed-rock containing no auriferous veins, or perhaps the Miocene layers, and thus the gold will become too fine and sparingly distributed to be payable.

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There is likely to be another lead, or ancient river deposit of Miocene age, beneath the decomposed older volcanic rock of the Ballanee Estate, between Myrniong and Ballan.

It used to be supposed that this older volcanic rock might be intrusive (*i.e.*, had burst up in the form of a huge dyke through the Silurian rocks), or that, if underlaid by Miocene gravels, those gravels would be non-auriferous; but, from experience subsequently gained elsewhere, these views seem erroneous, and I am strongly of opinion that the basalt in question is a lava-flow which has covered a lead of Miocene age, and that the lead is likely to be auriferous, on account of its being about on the strike of known auriferous quartz reefs to the north.

Its course would probably extend beneath the newer volcanic rock westward of Ingliston, and out between there and the Brisbane ranges, but it could not be expected to be remunerative, beyond where it leaves the Silurian, and rests upon a Mesozoic bed-rock.

As to the prospecting of the deep ground near Bacchus Marsh, or that lying between the Silurian outcrops of the Werribee gorge and the Brisbane ranges, there is no reason for supposing that such deep ground is likely to be richer in gold than the more northern localities already indicated, and which can be far more cheaply tested. It is out of the question to suppose that gold in payable quantity could have been conveyed into that deep ground from distant sources, so that, unless the underlying bed-rock contains auriferous quartz veins, in greater number, and of richer quality than it does where exposed to the north, the more widely spread deposits in the deep ground could not be expected to prove as remunerative as the patchy, though in places rich, deposits that have been found where the drifts are more concentrated, within narrower limits, and more accessible to the miner.

Gold in small quantity is stated to have been found at Bacchus Marsh in various wells, none of which reached the bed-rock, but this does not necessarily imply the existence of richer deposits below. It is quite likely that the widely spread Miocene deposits, or even the Mesozoic conglomerates, may contain gold where they rest on the Silurian bed-rock in the neighbourhood of auriferous matrices, but the probability of the gold being in remunerative quantity does not appear sufficiently strong to justify the heavy expenditure necessary to test them, unless encouraging results be first obtained in tracing the reefs or the gravels southward from the now known auriferous localities.

If it be an established fact that payable gold was found in gravel on the bed-rock, under Darley bridge, the next obvious step in prospecting would be to test the flats a short distance below, and as nearly as possible on the strike of that bed-rock.

In reference to the country between the Werribee gorge and the Brisbane ranges, there can be no doubt that deep ground exists, as a shaft put down near Rowsley is stated to have been sunk to a depth of 240 feet without reaching the bed-rock. I visited the locality, and saw the material from the shaft, which consists of clays and impure lignites. Though the surface is strewn with a heavy quartz drift, none appears to have been passed through in sinking. No water is reported to have been encountered, and it is is further stated, that the shaft was sunk to the depth mentioned by two men, with ordinary diggers' appliances, a notable instance of courage and perseverance.

Gravels or conglomerate would probably be here found resting on the Silurian bed-rock, and, whatever their geological age, would doubtless contain small quantities of gold, especially on a line southerly from the Werribee gorge, but it is not likely to exist in payable quantity.

Twenty-one years ago I personally took part in carefully prospecting the gullies and quartz reefs in the eastern portion of the Brisbane ranges without finding the smallest speck of gold, and the northern continuation of this non-auriferous belt passes under the deep ground westward of Rowsley.

Summarising the conclusions arrived at as to the gold-mining prospects of the Bacchus Marsh district, it can be predicted, that further careful prospecting, is likely to be successful, both as regards quartz and alluvial mining, in the neighbourhood of the Bullengarook plain; but that the prospecting of the deep ground to the south would be unlikely to result in valuable discoveries, and should at all events be deferred, until payable gold has been traced farther to the south than the auriferous localities known at present.

COAL.

The Mesozoic rock-formation, of which the edges are alone visible, probably extends under the plains to the south, and intervenes between the Tertiary layers, and the Silurian bed-rock. Though occupying the same geological position as do some rocks, which in other parts of the world contain coal seams, not even the thinnest layer of coal has to my knowledge been found in the Bacchus Marsh series of Mesozoic rocks, from the uppermost exposed layers down to the conglomerates which rest on the Silurian bed-rock.

It is not impossible that in the more central portion of the old basin, there may exist beneath the Tertiary beds, Mesozoic layers containing coal seams, but the possibility, in the present state of information, appears too remote to justify a recommendation that the expense of deep boring be incurred, except as a scientific experiment.

ARTESIAN WATERS.

There must undoubtedly be a large quantity of water which finds its way into the earth along the flanks of the Silurian ranges, and thence percolates underground through the looser Tertiary layers.

The vicinity of the Werribee Valley, from Bacchus Marsh to Wyndham, would be the most likely course for the bulk of this percolating water to pursue; but within such extensive limits as those bounding the Werribee plains the search would necessarily be chance-work, and though in the low-lying country near the Bay, such water would in places probably rise to the surface when tapped, there is no evidence that water tapped in bores on the plains anywhere from the parallel of Bacchus Marsh to that of Mount Mary is likely to be under pressure originating from a sufficient height to cause it to rise to the surface.

BUILDING STONES.

The stone from the Bald Hill and Goodman's Creek quarries is well known, having been used in the old Treasury and portions of the Houses of Parliament in Melbourne.

With careful selection, blocks of fair size and quality can be obtained, but, as a general rule, the stone is more fitted for plain than for ornamental work, having a tendency to earthiness, and though easy to work, is readily amenable to atmospheric influences, as it does not possess the property of gaining a hard siliceous "skin" from exudation of silica to the surface, which characterizes some freestones and renders them durable.

Though wanting in some of the necessary qualifications that constitute a first-class stone for large public edifices, it is well adapted for many descriptions of smaller buildings, and, were there a cheap and easy means of transit, would, no doubt, be extensively used.

Apart from all mineral resources, the property-owners in the Bacchus Marsh basin possess a source of wealth, which will never fail, in the excellent facilities that exist for irrigating their fertile lands from the upper portions of the never-failing rivers which run through them. One resident has already initiated this work, and no doubt others following his example will find in the surface far more permanent sources of wealth than any that may exist below.

In conclusion, I beg to acknowledge the courteous assistance rendered by all those residents of the district with whom I came in contact during the examination of the country.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

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HOWQUA HILLS DISTRICT.

Geological Surveyor's Report.

Sir, Camp-street, Talbot, November 3rd, 1882.

I have the honour to report that, in accordance with your instructions, I visited and examined the Howqua Hills country and other places in the Mansfield district, proved, or likely to be auriferous. My observations extended to the heads of the Lick-hole Creek, to the summit of Mount Bulla, and to about 10 miles up the river from Howqua Hills station. In this investigation, Mr. J. Rowe, proprietor of the station, and his son, Mr. W. Rowe, rendered valuable assistance with their knowledge of the country.

Geological formations.

The geological formations of the district examined consist of granite, Upper Silurian (partly metamorphic in character) and Devonian rocks. The boundary between the Devonian rocks of the Mansfield basin and the Silurian rocks of the Howqua and Jamieson, lies along, or to the north of the spur from Mount Buller, which divides the Delatite from the Howqua River. The Devonian rocks, consisting of horizontal or slightly inclined sandstones, shales, and conglomerates, occur about 15 miles up the Howqua from Mr. Rowe's station, and also in the upper portion of the Jamieson, and appear to extend thence over the Main Divide to the Macallister country in Gippsland.

The granite appears as a tongue on the southern slopes of Mount Buller; how far it extends eastward remains to be proved.

The summit of Mount Buller consists of hard schistose sandstones (Silurian), and a shoulder of the mountain, about 200 feet below the summit, is capped with dense basalt, probably a vestige of one of the Middle Tertiary lava-flows, such as form the Dargo High Plains, Connor's Plains, and Mount Useful.

South of the spur between the Delatite and Howqua rivers, and west of a line bearing southerly from the head of the Delatite, the Silurian rocks prevail, and consist of indurated schistose quartzites and sandstones, rubbly sandstones, shales, and slates, having a general north-westerly to west-north-westerly direction of strike.

Auriferous character.

Geologically speaking, there exists the probability that gold may be found wherever these rocks occur, but experience has proved throughout Victoria that it is only found in payable quantity in certain belts or groups of strata of varying width, separated from one another by zones, presenting perhaps exactly similar appearances, but nevertheless barren of, or very poor in gold. As a rule, the auriferous belts are wider apart, and at the same time narrower in the Upper than in the Lower Silurian rocks.

The Howqua Hills country contains one or two small proved auriferous belts, and may possibly contain others, though a considerable amount of prospecting has been done without making such discovery.

Alluvial workings

The principal alluvial workings yet proved are, Cameron's and Barney's creeks, which are branches of the Lick-hole Creek, a southern tributary of the Howqua; and Stockyard Creek, a northern tributary heading from near Mount Warrambat (Timbertop), and joining the Howqua below Mr. Rowe's station.

These creeks are now deserted, save by two or three men, but I learned that tolerably rich yields, including nuggets up to as much as 30oz. in weight, were once obtained from them, and that "specimens" were found in considerable quantity.

There can be no doubt but that this alluvial gold was derived from the denudation of auriferous quartz reefs in the immediate vicinity of where it was found, and that by means of diligent search, they also may be discovered, and prove durable sources of wealth. I would recommend the upper portions of the above-named creeks as promising places to prospect for auriferous veins.

From the information obtained as to the character of the gold, and the "specimens" found, it seems likely that the auriferous matrices will be discovered to be quartz veins traversing igneous hornblendic dykes, similar to those at Wood's Point. I noted one such dyke trending in a direction to cross Barney's Creek above the gold-workings, and in the creek are numerous boulders of igneous dyke-stone.

Such dykes are apt to vary greatly in character along their courses, being in some places narrow, hard, and devoid of quartz; in others wide, decomposed, and traversed by numerous veins.

Quartz workings.

The only auriferous quartz reef from which crushings have actually been taken was worked many years ago by Mr. Chenery, but was abandoned on account of the poor yields extracted by means of the appliances then used; it has lately been taken up again by Messrs. Edwards, Kidd, and party, under the title of the Mountain Chief Company.

This reef is situated to the south of the Howqua, about one mile from Mr. Rowe's homestead, and presents features of a somewhat peculiar character.

The strike of the reef is nearly east and west, or obliquely across that of the Silurian rocks, and it is traceable for some hundred yards in either direction from the main outcrop, which is of great size, being from 30 to 40 feet in thickness between the walls. The stone is principally greyish and bluish quartz, sometimes assuming the character of a quartzite, and more or less impregnated with specks, veins, and bunches of pyrites. In the exposed face of the outcrop, I measured one band 2 feet in thickness, consisting partly of solid pyrites, and partly of quartz densely impregnated therewith. In appearance and hardness, the pyrites resemble yellow copper-ore, but on testing, they prove to be magnetic iron pyrites.

Galena is present in nests and small veins.

Little or no gold can be seen in, or obtained with ordinary crushing appliances from the mineralized stone, but by means of special treatment good prospects of fine gold are obtainable.

Mr. Edwards states that his various rough assays, made with primitive appliances, of indiscriminately selected samples, have given results indicating yields varying from 5dwt. to 14oz. of gold per ton.

From the trials witnessed by me, and from Mr. Edwards' description of the proposed methods of treatment, coupled with the facts of there being an immense mass of stone easily available for immediate manipulation, and an unlimited and powerful water supply, I consider that there is a very durably prosperous future in store for the owners of the mine.

Several other similar lodes outcrop in the vicinity; all of them contain more or less pyrites, and yield dish-prospects of fine gold on samples of stone being calcined and crushed.

Mr. Rowe holds a lease between that of the Mountain Chief Company and the river, and has proved the existence of another very large east and west lode, from which he has obtained encouraging prospects.

General conclusions as to mining prospects.

In view of the facts observed, I beg to express the opinions :—

1st. That there is a great probability of payable reefs being found in the vicinity of the creeks already worked for alluvial gold.

2nd. That the success of the mining operations on the Mountain Chief and other adjacent proved auriferous lodes will depend entirely on the mode of treatment. There appears little doubt as to the gold being present in sufficiently remunerative quantity.

3rd. That though the successful development of the lodes will eventually furnish steady means of support for a moderate population, and there may yet be found in the gullies, creeks, and in the bed of the Howqua, alluvial gold sufficient to remunerate a small number of individual miners, or co-operative parties, the field, as a whole, is essentially one requiring capital for its development, and by no means a good "poor man's diggings" for a large population.

Soil.

There is good soil in the small flats along the river and the larger creeks, and on some of the slopes, but I saw nothing to attract a large selecting agricultural population.

There is a fair grazing country of limited extent around the station, and a larger area of inferior quality outside of that, but the mountains generally, on either side of the Howqua from the station upwards, are steep, lofty, rocky and sterile, capable of supporting but a small amount of stock, and not calculated to invite pastoral settlement on a large scale, though perhaps susceptible of being improved in places by means of clearing the scrub and timber.

Timber.

In some localities there is timber of good quality. I noticeed some excellent mountain-ash between Barney's Creek and the Howqua, and also in other parts of the ranges, but in places difficult of access.

Roads.

Taking the vicinity of Mr. Rowe's station as the probable future centre of population, there are but two means of access capable of being easily made available for wheel traffic. One of these lies along the Howqua from where the Mansfield and Jamieson road crosses the river; the distance is about 15 miles, but in travelling along it, it is necessary, in order to keep on the flats, to cross the river some thirty times, as the bends of the stream wind under steep and sometimes precipitous hill-sides. Some of the crossings could be avoided by means of cuttings round the bends, others could be improved as fords, and others bridged; it is simply a question of expense, to make this a practically level road. In coming from Jamieson a slight saving of distance might be effected by rounding the spur between the Jamieson and the Howqua, and striking the latter river a few miles above the Jamieson and Mansfield road. A proposed route from Jamieson up the Jamieson River for some distance, and thence across the ranges, would be too rugged, steep, and circuitous for wheel traffic, except at very great outlay, not justifiable under present circumstances.

The second of the two available routes—the surveyed line from Merrijig to the Howqua—is that now followed by bullock-teams, and is unquestionably the natural means of access from the Mansfield side. There is a good road already from Mansfield to Merrijig, whence to the Howqua the distance is about 10 miles. The Delatite River at Merrijig is the only large stream to be crossed. The track thence ascends about 1,000 feet to a saddle of the range between the Delatite and Howqua rivers, immediately west of Mount Warrambat, and then descends along the Stockyard Creek to the Howqua.

Portions of this road are decidedly bad at present for wheel traffic, but the worst could be improved at small expense; while, by cutting sidings along a judiciously chosen route, a moderately easy and uniform gradient could be obtained on both slopes. Such cuttings would not be very costly, as there is a considerable thickness of soil, clay, and rubble on the rocks, which are themselves for the most part soft near the surface, along the course of the road.

In view of the possible construction of a railway to Mansfield at no distant date, the road *viâ* Merrijig is certainly the natural and most easily improved means of access to the Howqua Hills. It may be further remarked, that the difficulties consist in the physical conformation of the country, and not in the scrub; any improvements to be effected would be properly the work of a road-making, rather than of a scrub track clearing party. In addition to the district already noticed, I examined a portion of the country between Deuran and the King River, and during such examination received great assistance and information from Mr. E. Tolmie and his sons.

The Devonian rocks extend from Deuran over to the fall towards Holland's Creek, where the granite is met with, and they also occur capping the granite still further in the direction of the King River.

At Stringy-bark Creek—the scene of the Kelly murders—gold has for some time been obtained, though not in very large quantities, from a run of gravel resting on decomposed granite in the creek bed ; this gravel is clearly a re-distribution of pebbles denuded from Devonian conglomerates which overlie the granite in the vicinity, and its auriferous character indicates that gold may be found—though most likely in a sparsely disseminated form—in those conglomerates at their contact with the older rocks.

From information afforded by Mr. Donald Tolmie, who has made prospecting expeditions up the King River, it appears that there is a considerable extent of country well worth examination towards the heads of the river ; it is very likely that Silurian rocks, as well as granite, may be found there underlying the Devonian rocks, and that, where the latter consists of conglomerates resting on Silurian rocks, into which creeks have eroded their channels, auriferous alluvial deposits may be found.

In addition to the assistance received from the gentlemen already mentioned, I beg to acknowledge that rendered by the Mansfield Shire Council through their President, Mr. McKenzie, and Mr. Curtis, one of their members.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

GEOLOGICAL SURVEYOR'S REPORT ON THE PROBABLE EXTENSION OF THE STAWELL LEADS.

SIR, Camp-street, Talbot, September 1st, 1883.

I have the honour to inform you that, in accordance with your instructions, I visited Stawell, and obtained mining information concerning the country between there and the Grampians, which—added to previously acquired personal knowledge of the district—enables me to submit the following report:—1st. As to the probable value of the extension of the Stawell leads. 2nd. The existence of a lead running parallel with the Grampian chain. 3rd. The advisability or otherwise of searching for coal in the Grampian sandstones.

Commercial-street lead.

The leads and other alluvial gold-workings of Stawell are shown on the geological map of that gold-field, prepared under instructions from the Department of Mines by Mr. Norman Taylor. The questions of most interest as regards alluvial mining are, the probable existence and value in the deep and wet ground, of the continuations of those leads, particularly the Commercial-street lead and the Deep lead.

The Commercial-street lead, known at various portions of its course as the 40-feet, 50-feet, 70-feet, and 25-feet lead, has been worked along a low range composed of Tertiary deposits, as far as where that range slopes down to Hooper's and Chambers' flats. From the ranges to the south, the Cumberland lead comes down, as though to join the Commercial-street lead. A reference to the geological map will show that, about a mile westward of the point to which the Commercial-street lead has been worked, a long point of exposed Silurian bed-rock slopes from the ranges south of the flats almost to the Pleasant Creek watercourse.

Three-quarters of a mile northerly from that point, and on the other side of the flat, is a similar point from the range to the north. There is no other possible course than beneath the flat between the two Silurian points referred to, for the continuation of the combined Commercial-street and Cumberland leads; together with any unproved leads that may exist beneath the Pleasant Creek and Hooper's flats.

On a line, therefore, between those two points, I would recommend those interested to put down bores to prove the position of the deep ground.

The existence of Wade's and Sussex "patches"—which yielded heavy gold, nearly on the meridian, and to the north and south respectively of the locality indicated, justifies the inference that there is a fair probability of the lead which undoubtedly exists there being payably auriferous.

Deep lead.

The Deep lead was worked with rich results on its course along the high ground north of Welshman's Flat, as far as the Ophir mine, near which the lead takes a sharp turn southward towards the flat. The Junction Company, at the northern edge of Welshman's Flat, obtained, from a large area of ground worked, varying

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results, but, on the whole, the gold appears to have been there too widely disseminated and patchy to allow of the profitable continuance of operations.

In Mr. N. Taylor's note (No. 3) a doubt is expressed as to whether the deep ground worked in the Junction mine, is really the continuation of that worked in the Ophir, or only a tributary, and so far actual mining does not appear to have determined the question. Neither does it appear that the Junction Company's workings ever reached the, as yet untried, deep ground beneath Welshman's Flat, the position of which was ascertained by means of bores put down by the Menai Company.

The geological map indicates exposed Silurian rock, as appearing a quarter of a mile westward of the Ophir. There is also either exposed or shallow Silurian rock along the southern margin of Welshman's Flat, and a point thereof slopes down to the flat a little westward of Wade's patch. The distance between the two exposures on a north and south line, a mile westward from the Junction mine, is about a mile, a third of which distance is occupied by the recent deposits of Welshman's Flat, and the remainder by the older gravelly deposits of the low ranges to the north.

Within that distance, however, must necessarily lie the extension of the Deep lead, combined with that of Welshman's Flat and the various tributaries of the latter, and the most probable position for such deep ground would be about the northern margin of the flat, a mile westward of the Junction mine.

As in the case of the Commercial-street lead, I consider that there is a fair chance of payable deep ground being discovered here, as the locality is so close to the meridian of proved shallow auriferous patches.

The discovery of payably auriferous ground in either of the two localities indicated, would lead to the testing of the hitherto untried, or only partly explored ground, beneath Welshman's, Eno's, and Hooper's flats, where there is reason to believe that payable deposits may be found.

There is not the least doubt but that the deep leads above referred to unite beneath the flat country westward of the area geologically surveyed, but I cannot recommend any exploration in search of that deep ground until some satisfactory results shall have been obtained at the localities, already suggested, which are nearer to the known auriferous belt of country.

The existence of deep ground still further westward, forming a lead running parallel with the Grampian range, and heading from the Main Divide some miles west of Ararat, is also indicated beyond a doubt by the physical and geological structure of the country, and the general outlet of such lead, together with the combined lead systems trending from Stawell, must lie between the eastern base of Mount Difficult and Glenorchy, but there are several considerations that render caution necessary in estimating the auriferous value of the deep ground in that direction. There is, first, the likelihood that the leads may merge into extensively spread deposits, in which the gold would be widely but sparingly disseminated. Secondly, that the Upper Palæozoic non-auriferous rocks of the Grampians, may extend beneath the flat country, and form the bed-rock on which the Tertiary deposits rest in place of the Silurian. Thirdly, there is the consideration, that, even though the bed-rock be Silurian, the deep ground towards the Grampians is far outside the known limits of the Stawell and Ararat auriferous belt, and it is not known, so far as I am aware, that there is another auriferous belt further westward, from which the drifts might have obtained a gold supply.

The supposition that gold could have been conveyed by natural forces from Stawell or its vicinity, and deposited in payable quantities in the deep ground towards the Grampians, is altogether untenable, and totally unwarranted by mining experience.

Many valuable suggestions for further prospecting may be obtained from a study of the physical and geological features and the positions of auriferous localities, as shown on the geological maps of the Ararat and Stawell gold-fields. A straight line bearing between N. 30° W. and N. 40° W. from Kangaroo Point, south of Ararat to the Welcome lead, north-west of Stawell, passes nearly along the central portion of an auriferous belt 30 miles in length from end to end, and only broken, as to the continuity of its auriferous character, by the granitic tract which separates the

Silurian rocks of the range west of Ararat, from those of Stawell and the Iron-bark range.

Though broken in continuity by the granite, it is very clear that the Silurian rocks of the two ranges are portions of one and the same group.

The width of the belt within which lie the gold-workings of the two fields—at right angles to its direction of strike—is, in places, as much as 8 miles, and within that width payable gold has been found over considerable areas, and in great richness, for the whole length of the belt that is occupied by Silurian rocks, and in places, even in the granitic tracts.

At the parallel of Stawell, the westernmost auriferous locality in the belt is that of the Frying-pan diggings; the easternmost is McEwen's patch.

At the parallel of Ararat, the westernmost appears, from the geological map, to be the Rocky Point lead, and the easternmost the Union Jack lead, but the richest and most extensive deposits appear, as a rule, to have been found along the central axis of the belt, or adjacent to a line from Ararat, through Stawell, west towards the Welcome.

As far as I am aware, no payable gold has yet been found in shallow ground, westward of a line from the Rocky Point lead to the Frying-pan diggings, and for that reason, the payable character of any deep ground to the west of that line appears very doubtful, there being no evidence that there are, in the Silurian rocks, in that direction, or that there were in those denuded during erosion of the lead-channels, any auriferous matrices whence alluvial gold could have been derived. As before pointed out, the belief that gold in payable quantity has been conveyed from within, to any distance beyond, the eastern or western limits of the known auriferous belt, cannot reasonably be entertained, but there are yet grounds for the hope of further discoveries within those limits, either in deep ground crossing the northern prolongation of the belt north-west of the Welcome, in the localities already suggested, in the gravel and cement deposits northward from McEwen's patch, and even in country around the Welcome and Four-post diggings, though there has already been much unsuccessful prospecting there.

I would also call attention to the great likelihood of other reefs than those already worked being found.

It is difficult to believe that the reefs worked at Stawell are the only ones, nor can it well be imagined that all the alluvial gold for several miles to the west was derived only from that vicinity. It was stated to me that some of the heaviest gold ever found on the field was obtained in some of the westernmost patches, at too great a distance from the known reefs to allow of the belief that it was transported from them during the denudation of their removed portions.

It may be that the auriferous veins or reefs, whence much of the alluvial gold was originally derived, were entirely removed by the denuding action which formed the Tertiary drifts; but it would certainly be unwise to take that for granted, without an effort to ascertain, if there are not some yet undiscovered reefs whose development may revive the prosperity of the gold-field, especially in view of the fact, that the known reefs at Stawell have yielded well to such great depths. Indeed, that very circumstance appears rather to have retarded outside reef-prospecting, as operations have been confined so much to the exploration to great depths of the known reefs within a limited area. It cannot be said that the deep exploration now in progress may not yet result very successfully, but it would at the same time be advisable to make strenuous efforts to find other reefs, at shallow depths, in the places where the richness of the alluvial ground indicates their probable proximity.

"Carney's patch," "Hodges' patch," and other diggings on the same line, indicate the probability of other "shoots" of auriferous quartz occurring on the western slope of the Iron-bark range, and it might be suggested that a system of cross-cutting in search of quartz outcrops be undertaken by means of surface trenches or drives at shallow depths, to cross the Silurian rocks at right angles to their strike, say, from the Iron-bark range down along the spur south of Welshman's Flat, on which have been worked so many alluvial patches, such as Canadian,

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Nuggety, Doctor's lead and others, in all of which it appears likely that the gold was derived from local sources.

As such trenching or driving proceeded, each vein, reef, or apparent track thereof, that might be intersected, could be further tested north and south along its strike.

The total length to be so cross-cut would be about 5 miles, but over much of that length the bed-rock is close to the surface, and the work would not be so expensive as might at first glance appear likely, and if the means were provided by general contribution of all those directly or indirectly interested in the prosperity of the field, no individual would suffer serious loss, even if total failure were the result. The probable average sum per foot could be very nearly estimated by those acquainted with the ground, and I believe that a total of £2,000 expended on actual trenching and driving would go a long way towards accomplishing the object in view. Were such a course decided on, arrangements might be made for the temporary reservation of the land for a certain width on either side of the line of cross-cut so that in the event of any valuable discovery being made the ground could not be "jumped" by outsiders until those contributing towards the work had a fair opportunity of participating in the results, according to the amount subscribed by each.

The sandstones of the Grampians have not been yet thoroughly examined geologically, and it would take a considerable time to effect this work; but though no fossils have yet been found in them, they have, on the ground of their general analogy to known fossiliferous rocks elsewhere, been provisionally classed in the Upper Palæozoic series as probably of the Devonian or Old Red Sandstone epoch—lower than the true carboniferous rocks, and unlikely to contain coal. The physical character of the Grampian ranges is such that the outcrops of a great vertical thickness of layers are exposed in natural section, and were there a coal seam anywhere within that thickness, its outcrop would surely have been seen before this by some of those who have traversed the ranges.

To the westward, the Grampian sandstones rest immediately on the metamorphic schists, so that any hope of finding coal in that direction is out of the question. It is impossible to say what may be the character of the concealed layers underlying those exposed at the Mount Difficult quarries; but unless some very favorable evidence, in the shape of carboniferous fossils, were found in the exposed layers, I would not recommend any expenditure on boring in search of coal, the existence of which appears very unlikely.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

SECTION II.

REPORTS RELATING TO THE PROGRESS OF DEVELOPMENT OF COAL MINING.

PREFATORY REMARKS.

A considerable access of information has been obtained during the past four years as to the character of the Mesozoic (carbonaceous) rocks of Victoria, the areas occupied by them that contain, or are likely to contain, workable coal seams, and the probable extent of the known seams.

With the exception of the general report and the addendum thereto, the reports in this section are the results of examinations made at the request of residents of the various districts, who desired advice with respect to proposed coal prospecting operations, or of the managers and directors of companies formed for the purpose of, and engaged in, developing actual discoveries of coal.

Here, also, the endeavour has been made to deter from expenditure in all cases where the geological conditions afforded no hopes of success, to impose caution in doubtful ones, and to encourage wherever warranted by circumstances.

The addendum to the Geological Surveyor's General Report gives a brief account of the latest developments, and of the prospects of Victoria as to the ultimate establishment of coal mining as a permanent industry.

FURTHER REPORT ON COAL SEAM IN THE PARISH OF BARONGAROOK, NEAR COLAC.

SIR, Office of Mines, Melbourne, August 6th, 1879.

I have the honour to report that, in accordance with your instructions, I visited and examined the mine of the Colac Coal Mining Company, the position of which was described in my previous report of about a year ago. At that time the coal-seam was exposed and driven on for a short distance on the eastern side of the creek only, and I recommended that it should be tested on the western side also. This has been done by sinking a shaft and driving a tunnel on that side.

The shaft, sunk about five chains westerly from, and at an elevation of about 70 feet above, the outcrop in the creek, reached a coal seam at 66 feet; this coal seam

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is stated to have been 7 inches thick on the S.S.E. side and 15 inches thick on the N.N.W. side of the shaft, with an underlay in the latter direction; but as the shaft had water in it, I could not go down and inspect it.

The tunnel was put in from a shaft which had been sunk through the coal on the west bank of the creek, and was driven about 40 feet in the direction of the above-mentioned shaft, along the coal seam. The coal is from 10 inches to 18 inches thick, the average being 12 inches, and shows no decided underlay except at the face of the tunnel, where a slight inclination south-westerly at about 5° is perceptible.

The shaft at the tunnel entrance has been sunk 37 feet, and is still going down through Mesozoic shales and sandstones containing numerous plant-impressions and thin laminæ of coal. Similar strata have been passed through in two shafts, sunk 150 and 115 feet respectively, the first of which is on the quarry reserve, and the other about one mile south-westerly from the company's workings. In the latter a layer of bituminous, inflammable clay was struck at the bottom of the shaft, and is stated to have been sunk into 18 inches without change.

Both these shafts were full of water and could not be examined.

For the information of the company, I beg to submit the following remarks. The coal is of excellent quality as a smith's or steam coal, but the seam is too thin, as now visible, to be profitably worked. It is impossible to say whether it is likely to increase in any particular direction, as no decided direction of dip has yet been ascertained. It is also uncertain whether the coal struck in the 66-foot shaft is the same seam as that driven on in the tunnel or another seam overlying the latter; the former, however, appears to be most probable. As the expense would be trifling, I would suggest that crosscuts be put in from the face of the tunnel for a distance of 10 feet each way, and if any marked underlay or decided thickening of the coal seam be proved, it will be advisable to follow it further in the direction of such dip or increase. If, from levels about to be taken from the shaft to the tunnel, and from the information afforded by the crosscuts, it appears that the seam struck in the shaft is not the same as that in the tunnel, it will be advisable to sink the shaft further to intersect the latter.

Should these tests all fail to show that the coal has a tendency to increase or dip in any direction, the advisability of spending more money on that seam will be very doubtful.

As regards sinking deeper in search of other seams, it can only be said that the strata are such as workable coal seams are likely to occur in; they are analogous to rocks in other parts of the world in which large coal seams exist; the fossil vegetation, and the coal already proved, indicate that the conditions necessary for the formation of coal were, to a certain extent, present during the formation of the strata, and may have been more so in the case of the lower and unseen layers.

To sink deeper will be a purely speculative undertaking, in which, from want of any sure data to judge by, the chances of success or non-success are equal.

Boring would be cheaper than sinking, and if by co-operation of the various companies a single deep bore were put down in a suitable locality, the question would be decided at a light cost to individuals, and a successful result would justify the immediate sinking of proper shafts, to utilize any valuable discovery made.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

REPORT AS TO THE PROBABILITIES OF OBTAINING COAL BY MEANS OF BORING IN THE LOCALITY OF THE BARREN PLAINS SITUATE BETWEEN ALLANSFORD AND PORT CAMPBELL.

SIR, Office of Mines, Melbourne, June 25th, 1880.

With reference to your instructions on the subject of the coal-bearing capabilities of the Barren Plains, situated between Allansford and Port Campbell, I have the honour to state, that I am in a position to report without specially visiting the locality, as I am already personally acquainted with the geological features of the district.

Between the coast line from Port Campbell to Warrnambool and a line from Allansford to Cobden, and thence to Colac, the country principally consists of sandy tracts, classed geologically as Upper Tertiary. Beneath these deposits there are exposed, in the cliffs on the coast line, and along various creeks inland, sandy, calcareous, and clayey beds of Middle Tertiary (Miocene) and Lower Tertiary (Oligocene) age.

In the Gellibrand River, and thence to the coast line nearly as far as Geelong, the prevailing rock-formation is Mesozoic, the carbonaceous rock of this colony.

North-westward from Allansford, to near Coleraine, the formation is newer volcanic, beneath which, in a few localities, appear the Middle Tertiary beds.

An area traversed by the Wannon River, and extending southward and south-westward from Coleraine, consists of Mesozoic carbonaceous rocks.

Boring or sinking alone can prove whether the Mesozoic rocks of Cape Otway and the Wannon underlie the whole Tertiary area between the two districts, but I think that there is a reasonable probability of such being the case.

In any search for coal which may be undertaken by the Government, the Mesozoic areas of the Western District should be most exhaustively tested, but before commencing operations an organized plan of search should be adopted, based on the result of more detailed geological examinations than have yet been made in that district.

In a matter of such importance, local claims should be disregarded until proper examination has been made, so as to ascertain the most favorable sites for testing the rocks by means of boring.

In any case, it would be preferable to bore first where the Mesozoic rocks are visible, rather than to commence where their existence is a matter of uncertainty, and where, if they do exist, it is beneath an unknown, but certainly very great thickness of superincumbent strata.

Were an outcrop of Mesozoic rocks found there, I would be inclined to recommend the Barren Plains as a suitable locality for a deep bore.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

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REPORT ON A GEOLOGICAL EXAMINATION ON A PORTION OF THE COUNTRY AROUND COLERAINE WITH A VIEW TO BORING FOR COAL.

SIR, Office of Mines, Melbourne, October 15th, 1880.

I have the honour to report that, in accordance with your instructions, I examined a portion of the country around Coleraine with a view to ascertaining the advisability of boring operations in search of coal.

As already indicated on the geological sketch-maps, the prevailing rock-formations to the north of the main road passing through Coleraine are trappean rocks and metamorphic schists, in which it would be useless to bore in search of coal.

To the south, however, the Mesozoic carbonaceous rocks appear near Coleraine, and apparently extend thence southward and south-eastward, under a large area of Tertiary and volcanic country. A shaft sunk to a depth of 330 feet near Coleraine passed through a number of small seams of impure coal, of which the largest was about 20 inches in thickness.

It is quite possible that seams of better quality may exist below, or that these seams may be found to improve in thickness and quality further to the south-eastward at a greater distance from the margin of the carbonaceous formation.

I would, therefore, beg to recommend that, when practicable, the Mesozoic carbonaceous rocks of the Wannon district be tested for coal by means of a few deep bores with the diamond drill, the first bore being put down a short distance south-easterly from Coleraine.

I have been given to understand that a large number of the inhabitants of the district would be willing to contribute towards a fund sufficient to pay for the use of the drill on the same terms as those adopted in other districts.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

GEOLOGICAL REPORT RESPECTING A DEPOSIT OF LIGNITE AT PHOINES, NEAR CASTERTON.

SIR, Office of Mines, Melbourne, October 15th, 1880.

I have the honour to report that, in accordance with your instructions, I visited the site of the supposed discovery of coal on the property of J. R. McPherson, Esq., Phoines, near Casterton.

The deposit is an impure lignite, occurring as a seam of about 3 feet in thickness, of which a portion is sufficiently pure to burn, and the remainder much intermixed with clay, sand, and mica. The seam is interbedded with layers of sand and clay, which constitute the alluvial or Post-Tertiary deposits of the creek flats; these rest on the metamorphic schists which constitute the prevailing rock-formation of the adjacent hills, and in which there is no chance of discovering coal seams.

I do not see the slightest hope of the deposit ever becoming of value as a lignite, nor can it be regarded as any indication of the existence of subjacent coal seams, and boring in the neighbourhood would not be attended with the least chance of success.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

GEOLOGICAL SURVEYOR'S REPORT RESPECTING THE PROBABLE EXISTENCE OF COAL BETWEEN GEELONG AND QUEENSCLIFF.

SIR, Camp-street, Talbot, Sept. 5th, 1882.

In reply to your memorandum on correspondence in reference to the opinion, expressed by a gentleman having experience of the English coal-fields, as to the promising appearance of the country between Geelong and Queenscliff, with reference to the probable existence of coal there, or between the Queenscliff road and Corio Bay, I have the honour to state, from personal knowledge, and from study of the detailed geological maps, that, except the small outcrops at Drysdale and Portarlington, no exposures of the carbonaceous rocks occur within an area bounded by a line from Geelong to Point Castries on one side, and the coast line from Point Castries to Geelong on the other, the whole track consisting of Upper and Middle Tertiary formations.

I have no doubt that the carbonaceous rocks underlie the whole of this Tertiary area, but at what depth it is impossible to say.

The gentleman whose opinion is quoted was possibly misled by some resemblance in surface configuration between the locality mentioned, and other places, where, in his experience, coal had been found; but although, as may be said of all the Victorian carbonaceous areas, there exists the possibility of discovering coal in the rocks of that age underlying the country between Geelong and the ocean coast, there is really no evidence at all to the effect that the particular locality mentioned is a more likely one than any other.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

GEOLOGICAL SURVEYOR'S REPORT ON THE SKIPTON COAL SEAMS.

SIR, Office of Mines, Melbourne, May 19th, 1883.

I have the honour herewith to report on the coal seams near Skipton, which I visited and examined in accordance with your instructions.

The seams occur about a mile and a half up the Emu Creek from Skipton, and the existence of one of them was first accidentally discovered while sinking a shaft in search of a supposed quartz reef, at a spot where the creek has cut through the basalt of the plains into the subjacent formation.

Four shafts, two on each side of the creek, have been sunk. The two on the eastern and one on the western side of the creek are on the northern seam; the fourth shaft, on the western side of the creek, has revealed another seam to the south of the first.

The layers in which the seams occur are light-drab coloured, and greenish, earthy, and fine sandy shales, containing root-like fragments of fossil wood; some of the shales exhibit a jointed structure, the joint planes being coated with carbonate of lime.

These layers, with the contained seams, have a north-westerly strike, and dip to the north-east at 70°.

Three-quarters of a mile south-eastward, there are indications of the presence of Silurian rocks near the surface, while some miles to the northward occur exposures of granite.

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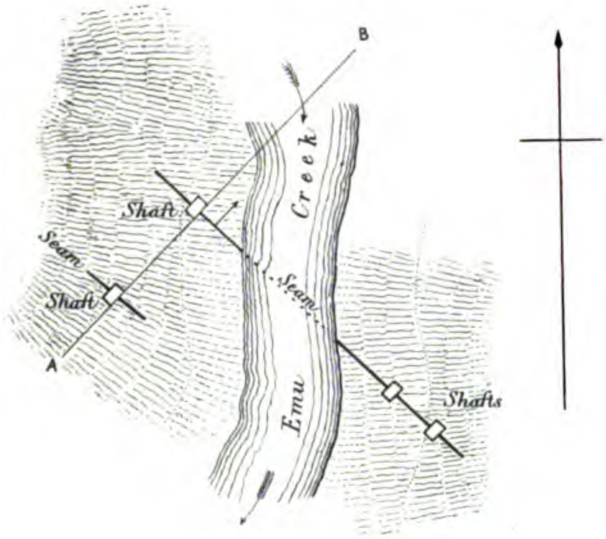
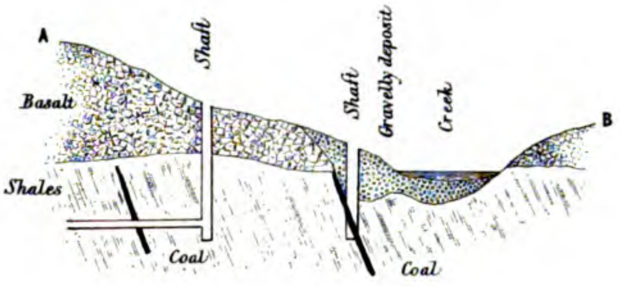
SKIPTON COAL SEAMS

Plan



Section on Line A.B.



Scale 80 feet to 1 inch

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The seams and their containing layers, so far as exposed, thus dip towards the nearest unmistakable exposures of the Palæozoic bed-rock.

After careful consideration, I can come to no other conclusion, than that the formation in which the seams occur must be older than Tertiary. I know of no Tertiary formations whatever that exhibit the high rate of inclination above recorded, and the appearance of the shales, decomposed as they are, nevertheless indicates a more remote geological period. So far there is no evidence in the shape of fossils by which the geological age of the shales can be determined, but that they are older than Tertiary appears certain.

To the west and south-west, for scores of miles, extends a great area consisting at the surface of basalt, with occasional tracts of Upper Tertiary or Post-Tertiary limestone.

Beneath this area no one can predict what may or may not be discovered between the surface formations and the Palæozoic bed-rock.

As already stated, the coal seams are nearly vertical; the northern one is about 1 foot, and the southern is stated to be from 2 to 6 inches in thickness. The latter I could not examine *in situ*, the shaft being full of water.

To the sight the coal presents a very superior appearance; the fracture is that of a true coal; it is clean, bright, and perfectly black, with resinous lustre. On handling, however, it crumbles readily; it yields to the nail and gives a dull-brown streak. On being dried, it pulverises readily and burns with difficulty, emitting little or no flame or smoke, no gas, and smouldering dully to an earthy ash.

From consultation with Mr. J. C. Newbery and examination by him of the coal, I can describe it as resembling, to a certain extent, a disintegrating anthracite, but differing therefrom in being soluble in potash solution. It contains sulphur, and yields no bituminous products or gas; percentage of ash about ·31, or nearly one-third.

This absence of all desirable qualities, so totally at variance with the appearance of the coal, cannot be accounted for merely by the recent atmospheric influences to which it has been subjected; a piece of Mesozoic coal from the South Gippsland ranges, or from Cape Patterson, taken from a creek bed or from within tidal influence, burns readily.

It need scarcely be said, after the above observations, that the Skipton coal, as now visible, is utterly worthless as a fuel.

The question arises, whether its presence may not be an indication that other and better seams may occur.

As before stated, there is an immense area of basaltic country, of the subjacent deposits of which nothing is known, nor possibly can become known save by actual experiment.

A shaft, known as No. 2 shaft, has been commenced near Skipton, but has not penetrated the basalt; to sink this shaft into the layers beneath, would be a ready means of ascertaining whether there is any change of character in those layers as compared with those where the seams occur, but for purposes of deep prospecting it would be better to select a site a few miles westward from Skipton, more towards the centre of the area, of which the subjacent deposits are unknown.

In making these suggestions, however, it is to be distinctly understood, that I do so only in view of the fact that without experiment nothing can be known.

There is absolutely nothing to show that the undertaking would be likely to prove profitable; it would be merely an experiment that might, or might not, bring to light hidden sources of wealth, and it is only as such an experiment, to be made by those who can afford the risk, that I can recommend the further sinking of the shafts, or the putting down of a deep bore.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

REPORT RESPECTING BORING FOR COAL AT THE CARRUM SWAMP.

SIR, Camp-street, Talbot, December 8th, 1881.

In reply to your memorandum on the memorial (returned herewith) of residents of Mordialloc and Dandenong, requesting that boring in search of coal be undertaken at the Carrum Swamp, I have the honour to submit the following observations:—

It is geologically possible that Mesozoic carbonaceous rocks may underlie the Tertiary formations within the triangular area referred to in the memorial; it is also possible that these rocks, if so occurring, may contain coal seams.

If the Mesozoic rocks do exist, they either constitute the extreme eastern verge of the Bellarine and Cape Otway series, which, as evidenced by the thin edge exposed near Mornington, pass under Port Phillip; or else they form a sort of narrow isthmus connecting the Bellarine and Otway Mesozoic area with that of Western Port. The narrowest part of such isthmus would be about Cranbourne. In either case, the Mesozoic rocks, if they do occur, must necessarily thin out northward and eastward from Mordialloc, and consequently there would be more chance of piercing them in bores near Mordialloc than there would be further inland.

The so-called "trap-rock" met with in the bores already put down, is the basalt of the older volcanic period—a Middle Tertiary lava flow—probably an extension of the great older volcanic layer, which, though partially covered by newer deposits, extends from Brandy Creek to Western Port, and fills, or partly fills, a great basin eroded during early Tertiary times, and subsequently to the formation of the Mesozoic rocks.

There is clear evidence that the Mesozoic rocks, during the erosion of this and other similar Tertiary basins, were entirely denuded over considerable areas from the subjacent Silurian and granite. Any Mesozoic rocks that underlie the Tertiaries between Mordialloc and the Koo-wee-rup Swamp are therefore attenuated vestiges, and have been subjected to infinitely more "disturbance" from erosive agencies, than has taken place in the larger Mesozoic areas. As to "disturbances" affecting the Mesozoic rocks, and arising out of actual movements of the earth's crust, there are positively no indications that such causes were less active near Port Phillip than elsewhere, and wherever they did occur, they would not affect the coal seams, otherwise than by causing faults and displacements, without in any way influencing the thickness of the seams.

The depression occupied by the Carrum Swamp, is in itself no more an indication of coal, than are the geologically similar depressions of the Albert Park Lake and the North Melbourne Swamp.

I know of no limestones among the Mesozoic rocks of Victoria, and very much doubt that those referred to in the memorial as "carbonaceous" are any other than the common Tertiary limestones, which are no indication of coal one way or another.

If only for the sake of gaining information, and the probability of finding artesian water supplies, I would advocate boring in the locality proposed in the memorial, but in searching for coal seams, I have no hesitation in respectfully, but unequivocally, stating the opinion that it would be most injudicious to remove the diamond-drill from the Kilcunda and Cape Patterson district, where there is reasonable hope of finding payable coal, to a locality where the very existence of the proper rocks is problematical, and the occurrence of workable coal still more so.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

V645

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GEOLOGICAL SURVEYOR'S REPORT ON THE COAL SEAMS CUT IN THE SHAFT OF THE CAPE PATTERSON COAL MINING COMPANY, NEAR CAPE PATTERSON.

Office of Mines,
Melbourne, June 14th, 1882.

SIR,

In accordance with instructions, I have the honour to submit, for the consideration of the Honorable the Minister of Mines, my report on the coal seams exposed in the shaft on the lease of the Cape Patterson Coal Mining Company, near Cape Patterson.

The shaft is that known as Davis' shaft, and was sunk many years ago.

In 1873, the shaft was cleared so as to enable me to descend and measure the seams, and the section then taken appears in the Geological Progress Report No. I., page 22, together with measurements of seams outcropping on the coast in the vicinity.

No drives existed at that time, but on the occasion of my recent visit (June 10th, 1882) short excavations had been made along the seams, thus enabling a somewhat better estimate to be formed as to their character.

Subjoined are the measurements taken in the shaft in 1873, and those taken in the drives during my recent inspection :—

Measurements in Shaft, 1873.

	Ft.	in.
Upper seam coal	1	4
Dark shale	0	11
Black metal	0	2
Coal	0	6½
	2	11½

Measurement in 1882.

	Ft.	in.		Ft.	in.
In drive on upper seam coal with irregular partings of shale, clay, and impure coal, but less than in shaft ...	2	6	to	2	8

The top of this seam is about 56½ feet beneath the surface. Below and separated from it by 2¼ feet of shale is a small seam of 4 inches in thickness, and at a depth of 73′ 6″ is the top of the lower seam, the measurements of which are as follows :—

1873.—*Taken in Shaft.*

	Ft.	in.
Coal	0	3
Dark shale	0	8
Coal	0	3½
Indurated clay	0	3
Coal	1	2
Shale	0	8
Coal	0	2½
Total	3	6

1882.—*Taken in Drive.*

	Ft.	in.		Ft.	in.
Coal	0	2			
Band	0	4			
Coal	0	2½			
Band	0	10			
Coal	1	10	to	2	0
Total ...	3	4½	to	3	6

The total depth of the shaft is 80 feet.

The discrepancies between the measurements show how variable in extent and thickness are the impure partings, and it would be no matter of surprise to find, in driving on the seams, that in some places they consist entirely of coal from roof to floor, and in others are even more divided by partings than as above recorded.

Allowing for such variations, I would estimate that an aggregate thickness of 4 feet of marketable coal would be likely to be obtained from the two seams. The yield might possibly be more, but it is not safe to over-estimate.

The coal seams here have an inclination south-westerly or seaward, and, should that be continuous, they will rise to the surface inland.

The evidence, however, of the rocks along the coast, leads to the belief that a "roll" occurs, and that further inland the coal may be expected to change its inclination to a northerly, or north-westerly direction.

Actual working alone can prove this, but, in the meantime, there is no doubt but that the seams underlie a considerable area, and that, should they maintain an average of 2 feet each of marketable coal, there will be at least several hundred thousand tons obtainable with tolerable ease, from comparatively shallow depths.

In addition to the small size of the seams, the evils to be encountered in working them are likely to be, irregularity of thickness and impure partings, faults and intersections by lava-dykes, and influxes of water. In spite of such disadvantages, I believe that, with proper appliances, care, and rigid economy, there is a reasonable probability of the Cape Patterson coal seams being worked at a moderate profit.

As it may be required of me at a future date to deal more extensively with the subject, I withhold till then a number of observations on the general character of the rocks, their relation to those of the Moe district, and other matters bearing on the search for coal in Victoria.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

GEOLOGICAL SURVEYOR'S REPORT ON THE COAL SEAM RECENTLY CUT IN THE SHAFT OF THE VICTORIA COAL MINING COMPANY, CAPE PATTERSON.

Office of Mines,
Melbourne, Sept. 11th, 1883.

SIR,

I have the honour to report that, in accordance with your instructions, I went to Cape Patterson, and examined the coal seam recently cut in the shaft sunk on the Victoria Coal Mining Company's lease.

The shaft is about 3½ chains north-easterly from the old shaft, from which the coal seams were worked many years ago, and on the inland side of the basaltic dyke which outcrops on the coast, and was found to fault the seams in those old workings.

Four coal seams have been cut in the new shaft, which has passed through the ordinary sandstone and shale measures of the district.

The first seam, struck at 42 feet, is reported to be 3½ inches thick; the second, at 98 feet, 12 to 14 inches. The timbering of the shaft prevented my seeing these seams, so that I can only give the manager's statement as to their thickness, but the quality of the coal is excellent, while the size of the pieces corroborate the statement with respect to the lower seam.

The third seam, which I was able to examine, was struck at 101 feet, and in one side of the shaft shows 2 feet 6 inches of coal with trifling impure partings. A drive along the coal S.E. about 6 feet, and thence N.E. 10 feet, shows the distance between the roof and floor of the seam to be from 2 feet to 2 feet 6 inches, of which the lower portion, of from 12 to 18 inches, is solid coal of most excellent quality, the remainder being composed partly of thin bands of coal and partly of interbedded "clod," or impure coal and shale.

At the extremity of the N.E. drive, a fault cuts off the coal, and the direction of the fault passes thence through the shaft, where it was encountered during sinking, and where the coal was found to be broken and bent downwards.

At 108 feet a 6-inch seam was struck, which I was unable to inspect.

The fault above mentioned unmistakably throws the coal seam down on the inland side; it is uncertain to what depth, but there is no reason to doubt that the coal continues north-easterly, or inland, beyond the fault.

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From examination of the rocks on the coast line, I feel convinced that the coal seams of Cape Patterson will be found to dip north-easterly, and to underlie a very large extent of country in that direction.

The results obtained by means of recent operations, as well as of those twenty years ago, when 2,000 tons were raised, of which a large portion was brought to Melbourne, coupled with the excellence of the coal itself, are sufficient warrants for vigorously prosecuting the search for the inland continuation of the seams, while the geological indications justify the opinion, that they are likely in that direction to assume a better defined and more permanent character.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

REPORT ON THE MOE COAL MINING COMPANY'S MINE AT MR. J. STEPHENSON'S SELECTION, NEAR MOE.

SIR, Camp-street, Talbot, January 3rd, 1883.

I have the honour to report that, in accordance with instructions, I proceeded to the Moe Coal Mining Company's property near Moe, and having examined the work done in tracing the coal seam since the date of my last report, made rough surveys, and took levels, to enable me to indicate the best course to be pursued in further developing the mine.

The present scene of operations is in a gully, which runs southerly from Mr. W. Stephenson's into Mr. J. Stephenson's selection, and joins a creek which flows easterly through the latter into the Narrican. The coal outcrops in the bed of the gully within Mr. J. Stephenson's block, near the boundary between the two selections, and, since the date of my last report, a tunnel has been driven from the gully north-westerly into the western bank about 40 feet, and the coal traced therein beneath its proper roof.

At the face of the tunnel the coal is from 2ft. 6in. to 2ft. 8in. in thickness, with only one thin insignificant clay parting. The roof is a thick-bedded sandstone, the floor a somewhat rubbly clay shale, with a thin layer of clay immediately below the coal. At the tunnel face the dip of the coal is to the south-west; but this appears to be merely local, the observations made, indicating the general dip to be more directly southerly, if not slightly to the east of south, at an angle of 10°, or an inclination of 1 in 6.

The coal cakes very slightly in burning, but nevertheless, from rude experiments made, appears likely to yield a good coke; it is unquestionably an excellent coal for steam, forge, or household purposes, and in its present thickness and quality, as seen in the tunnel, constitutes a remuneratively workable seam, provided only it be proved to extend over a sufficient area and the requisite carriage facilities be provided.

With regard to ascertaining the extent of the seam, the following are my observations and recommendations as to the preliminary steps.

The gully in which the outcrop occurs, trends southerly from the outcrop and tunnel some 30 or 40 chains before joining the creek flowing easterly into the Narrican.

The approximate rate of fall of the gully-bed for the distance named is about 1 in 8 to 1 in 7, while the coal seam inclines generally in the same direction, but at the somewhat higher slope of 1 in 6.

Taking the gully as the basis of operations, I suggest the sinking of a series of holes at moderate intervals from the tunnel down along the gully to the creek; such holes to be close together (say 100 feet apart) at first, and the intervals to be widened to 200 or 300 feet as each successive hole proves the extension and permanence of the seam. In the event of any one hole not reaching the coal at, or a few feet beyond, the expected depth, to sink other holes between it and the last in which coal was struck, so as to ascertain whether a "fault," or a "roll," has displaced or altered the inclination of the seam, and, if so, in what direction to search for its continuation. Generally, to adhere to the principle of patiently tracing out and accurately ascertaining the characteristics of the coal seam, before entering on any works for the purpose of mining the coal for market, and bearing in view that the company does not require to mine and bring out a quantity of coal to lie at the surface and spoil, but to obtain the most accurate and extensive information and assurance as to the permanence of the coal, and the existence of a readily available supply to be mined and brought out when the facilities for conveyance are at hand.*

Having once proved the coal to extend in workable size and quality to near the junction of the gully with the creek, an adit could be driven from near that locality to meet the coal on its underlay; the seam could then be followed easterly and westerly along its strike, and also worked on the rise towards the north.

A good line for a tramway is obtainable along the creek from the junction of the gully to the surveyed railway line along the Narrican Valley; the distance does not exceed one mile.

While making examinations in company with Mr. Ledger, the company's manager, I discovered in the bed of the Narrican, a few chains below the junction of the creek, and within 100 yards of the surveyed railway line, a coal seam, the outcropping edge of which just appeared above the water. This seam rests on the proper Mesozoic rock floor, but is covered by the alluvial gravel deposits of the creek flat, so that its true thickness cannot be ascertained till followed beneath its proper roof; the exposed thickness is about 10 inches of good coal; its apparent underlay is to the south-west, and it undoubtedly extends into the properties on both sides of the Narrican, but it is impossible, at present, to form any judgment as to its relation to the seam in Mr. Stephenson's selection.

In conclusion, I beg to state that the observations made recently have tended to more than ever confirm the opinions—1st, that the known seam in the ground held by the Moe Coal Mining Company is well worthy of thorough trial, the facts so far ascertained all tending to show that the seam is likely to prove capable of being profitably worked; 2nd, that, as indicated on several occasions during the last ten years, the Narrican Valley is a promising locality in which to search for deep-lying coal seams.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

GEOLOGICAL SURVEYOR'S REPORT ON THE HAZELWOOD COAL MINE.

Office of Mines,
Melbourne, May 31st, 1883.

SIR,

I have the honour to report that, in accordance with your instructions, I visited the coal mine near Hazelwood and inspected the adjacent country.

A considerable amount of work has been done in following the seam since my last visit of several years ago; but, as operations had lately been suspended, the workings were full of water, and I could not see the developments effected.

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* This work has since been carried out, and the coal has been traced down its incline for a distance of nearly half-a-mile from the outcrop, and found to preserve an undiminished thickness and quality.

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It is stated, however, that, in following the coal on its underlie, an increase in thickness to 4 feet has been proved, and, judging from what is visible, there appears no reason to doubt this statement.

The coal is soft, but appears likely to prove an excellent gas and coke coal, and I would recommend that a full report on the character and economic value of the samples sent down by me be obtained from Mr. J. C. Newbery.*

So far, no existing selections appear likely to prejudice mining interests, but I would recommend that an area about 4 miles square be reserved from selection, pending further exploration on the seam.

I have the honour to be, Sir,
Your most obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

Melbourne, 26th June, 1883.

REPORT ON SAMPLE NO. 5550.

Coal from Hazelwood.—Black, friable, bituminous, caking coal.

Upon analysis it gives in 100 parts—

Water...	1·65	
Volatile matter...	15·95	
Fixed carbon ...	70·40	Coke.
Ash ...	12·00	
	100·00	

The coke is of a very firm character. The ash is slightly ferruginous, and probably contains matter derived from the infiltration of surface waters.

J. COSMO NEWBERY.

GEOLOGICAL SURVEYOR'S REPORTS ON THE STRZELECKI COAL SEAMS.

SIR, Camp-street, Talbot, August 19th, 1882.

I have the honour to report that, in accordance with your instructions, I inspected the coal seams recently exposed in shafts sunk under the directions of Mr. Augustus Eyre in the Strzelecki ranges, 12 miles north from Anderson's Inlet.

The main seam is exposed in the beds of two branches of a creek running eastward into the Tarwin, and is the same as that described by me in Progress Report No. III., pages 156–7, as the Strzelecki seam.

When I examined it nine years ago, only the exposure in the creek bed was available for inspection, and the section was as follows:—

	Ft.	in.
Surface soil, clay, and rotten shale ...	4	0
Coal ...	0	8
Soft earthy shale ...	0	11
Coal—deteriorated by exposure ...	2	9
Coaly shale ...	0	3
On sandstones and shales.		

A bore close to this outcrop was put down, and, though no definite information could be obtained by me, the general statement was made that, in a depth of between

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* See copy of Mr. Newbery's Report herewith.

200 and 300 feet, an aggregate thickness of 10ft. 6in. of coal in various seams was passed through.

On the occasion of my recent visit, I found that two shallow shafts had been sunk and had cut the coal seam. The first of these is in the north-east portion of P. Shingler's selection, and about 100 yards distant from the outcrop and bore above mentioned. Subjoined are the measurements taken at the four corners of this shaft, which is 8ft. long and 5ft. wide, and attached is an illustrative sectional diagram.

N.E. Corner.	Ft.	in.
Surface rubble and shale	3	0
Coal—decomposed, but likely to prove good, if followed into solid ground	1	0
Greyish-yellow, rubbly shale	2	5
Coal, good	0	8
Grey shale	0	6
Coal—top portion (6in.) shaly, but lower portion (1ft. 6in.) very good	2	0
On sandstone floor.		

N. W. Corner		
Surface rubble and shale	3	0
Coal (as in N.E. corner)	1	3
Rubbly shale	2	1
Coal, good	0	8
Shale—lower portion (5 inches) almost a coal	1	4
Coal, very good	1	2

S.E. Corner.		
Surface soil, decomposed edge of upper seam, and shale	4	6
Coal, good	0	8
Shale	0	6
Coal—top part (4in.) shaly, lower part (1ft. 2in.) good	1	6

S. W. Corner.		
Surface soil, decomposed edge of upper seam and shale	4	6
Coal, good	0	9
Shale, coaly	0	6
Coal, very good	1	7

The coal seams and strata are here very nearly horizontal, there being only a slight apparent southward inclination at about three degrees.

The lower portion of the coal, from 14in. to 19in. in thickness, is of great excellence, hard, clean, bright, and burning well; it is an excellent steam and household coal, and appears superior in heating power to the New South Wales coal.

The second shaft is about a mile and a quarter south-south-east from the first, to the south of E. S. Smith's selection, on the bank of a creek flowing south-eastward, and is 5ft. deep, showing a thickness on the bottom of from 24in. to 27in. of coal; there are a few thin, irregular, clayey partings, and the coal has deteriorated, owing to its exposure, but I have not a doubt that, if followed into the hill, it would be found a thoroughly good marketable coal.

It is nearly horizontal, and appears to be the same as the main seam in the other shaft.

The indications afforded by the above-described exposures are as promising as, if not more so than, those of any other known occurrence of coal in Victoria; the low-lying position and nearly horizontal bedding of the coal justify the opinion that it will be found to extend beneath the wide area, especially to the north, south, and west.

I have no hesitation in recommending the thorough testing of this part of the country, and in expressing the opinion that properly directed efforts in this direction are likely to prove successful.

Such testing operations should be carried on in two directions :—1st, to explore the known seams; 2nd, to search for others beneath them.

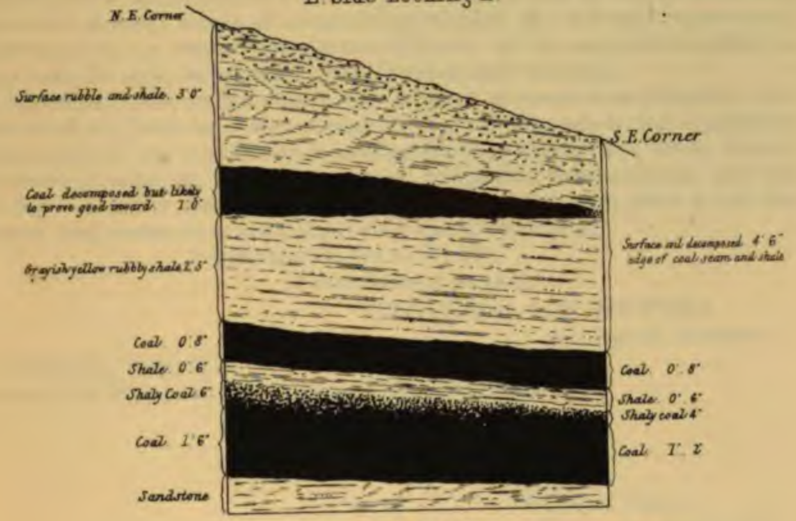
1894.

VICTORIA.

STRZLECKI COAL SEAM

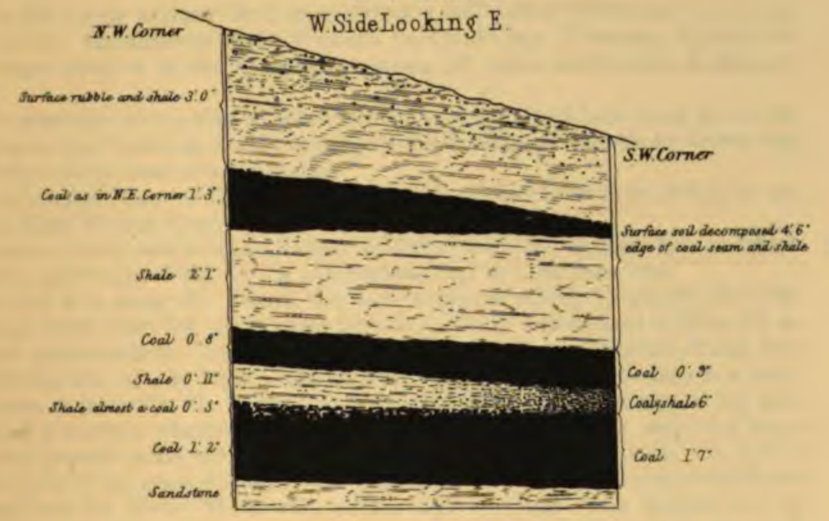
Nº 1 Shaft

E. Side Looking E.

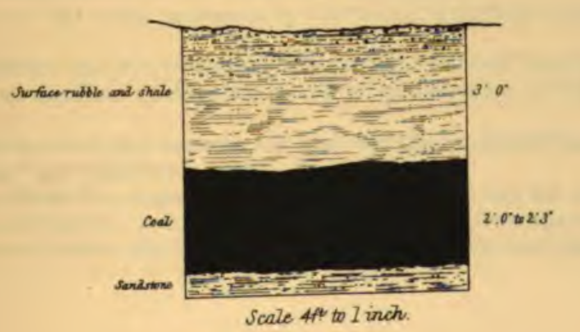

N. E. Corner
Surface rubble and shale. 3' 0"
S.E. Corner
Coal decomposed but likely to prove good inward 1' 0"
Surface soil decomposed 4' 6" edge of coal seam and shale
Grayish yellow rubbly shale 2' 5"
Coal 0' 8"
Shale 0' 6"
Shaly Coal 6"
Coal 1' 6"
Sandstone
Coal 0' 8"
Shale 0' 6"
Shaly coal 4"
Coal 1' 2"

Nº 1 Shaft

W. Side Looking E.


N.W. Corner
Surface rubble and shale 3' 0"
S.W. Corner
Coal as in N.E. Corner 1' 3"
Surface soil decomposed 4' 6" edge of coal seam and shale
Shale 2' 1"
Coal 0' 8"
Shale 0' 11"
Shale almost a coal 0' 5"
Coal 1' 2"
Sandstone
Coal 0' 3"
Coaly shale 6"
Coal 1' 7"

Nº 2 Shaft



Scale 4ft to 1 inch.

For the first, tunnels should be driven into the hills along the seams. Taking the vicinity of the first shaft as a starting point, it can be seen that a tunnel 7 feet in height would follow an aggregate thickness of at least 3 feet of coal to start with, and would afford a ready means of ascertaining whether the different seams unite, increase, or improve, as traced beyond the influence of the atmospheric action to which they must for ages have been subjected along their outcrops.

With reference to the second object, this locality, or some more accessible spot to the southward, can be strongly recommended as suitable for deep-boring operations.

Independently of any statements respecting the bore already put down, there is a fair likelihood of other coal seams being found underlying those exposed, and this locality being in a nearly central portion of the carbonaceous area, there is also the probability of such seams here attaining their greatest thickness.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

Office of Mines,
Melbourne, November 21st, 1882.

SIR,

I have the honour to report that, in accordance with your instructions, I re-visited during my late examination of the Western Port and Cape Patterson district, the coal outcrops situated in the Strzelecki ranges, 12 miles north from Anderson's Inlet.

On the occasion of my visit of some months ago, holes had been sunk to cut the seams close to their outcrop, and in my report the driving of tunnels to further test the extension of the coal was suggested.

On the southernmost of the two outcrops, a tunnel has since been driven by the Strzelecki Coal Mining Company.

This tunnel starts, and extends 50 feet easterly, from the shallow hole in which I reported a thickness of 2ft. 6in. of deteriorated coal to have been cut.

From this hole along the tunnel the coal improves rapidly in quality, but dips underfoot, a blind shaft 3ft. deep, about 20ft. in, proving a thickness of from 2ft. to 2ft. 6in. of excellent coal. Immediately above this, an irregular stratum of coal first appears in the side of the tunnel, and improves inward towards the face to a well-defined seam of from 2ft. 6in to 2ft. 8in. in thickness. On the occasion of my visit it appeared uncertain whether there were two distinct seams, or only one seam faulted, the ground being too rubbly and broken, and the blind shafts too full of water, to allow of the question being then determined; but since then more work has been done, and Mr. Henry Hine, who resides near the mine, now informs me by letter that the lower seam has been found to stop short, thus showing that there is but the one seam faulted, and that the coal in the end of the tunnel is a continuation, beyond the fault, of that on which the tunnel was commenced.

The inclination of the seam, as shown by the tunnel, is slightly to the south of east.

Beyond insignificant and non-persistent thin partings, the coal is unbroken from roof to floor, and of excellent quality, possessing a special value in being a good coking coal.

There is a thin layer of clay between the coal and the sandstone floor, and this will afford "holing," and facilitate working.

The next step which the company should take, would be to test the extension of the seam in various directions, commencing at short distances from the outcrop, and extending operations further afield, as the trend and dip of the coal become better known.

former, and, on this account, the Bacchus Marsh sandstones are treated as representing a group distinct from the other Mesozoic rocks of the colony.

The Bacchus Marsh sandstones occur between the Werribee and Lerderderg rivers, a short distance above their confluence at Bacchus Marsh, and extend in disconnected areas, much covered by volcanic layers, up the Werribee Valley as far as Greendale and Ballan. They consist principally of from coarse to fine whitish and yellowish-brown sandstones, of variable degrees of hardness; the lower beds of the series, which rest on the Silurian rocks, in many places consist of conglomerate. Outliers of conglomerate of the same group also occur, capping spurs on either slope of the Silurian range separating the Lerderderg and Werribee rivers.

At Darley, a few miles from Bacchus Marsh, is a coarse unstratified conglomerate, consisting of a soft earthy base, which contains, amongst other fragments, sub-angular pieces of granite of a different character to any occurring *in situ* in the district, and I remember to have heard the late Sir R. Daintree state that some of these fragments resembled no granite he was acquainted with occurring as a rock-mass nearer than Queensland.

The general appearance of the conglomerates, and the character and mode of arrangement of their materials, is suggestive of transport by marine glacial action, though, as remarked by Mr. A. R. C. Selwyn, grooved or ice-scratched pebbles have not been observed. Patches of similar conglomerates occur near Heathcote, and also associated with yellow sandstones on the Coliban River and between Kyneton and Heathcote.

The fossil-plants found in the Bacchus Marsh sandstones have been figured and described by Professor McCoy in Decade No. II. of his Prodromus of Victorian Palæontology; they comprise three forms of fossil ferns, namely, *Gangamopteris angustifolia* (McCoy), *G. spatulata* (McCoy), and *G. obliqua* (McCoy), and are regarded by Professor McCoy as indicating the relationship of the rocks wherein they occur to the "Talchir" beds of the Indian coal-field.

MESOZOIC ROCKS OF THE WANNON, CAPE OTWAY, BELLARINE, AND BARRABOOL HILLS.

The Mesozoic rocks of the Wannon appear from beneath overlying Tertiary and volcanic layers in the Wannon River, between Hamilton and Coleraine, and extend thence westward to the Glenelg River, where they disappear under the Tertiaries; they extend only a short distance northward from the Wannon, as at Coleraine they are seen to be bounded on the north by the trappean rocks, and a short distance north of Casterton by the metamorphic schists. Southward, they are visible as far as Digby, where they disappear under the Tertiaries. Even where near the surface, the Mesozoic rocks of the Wannon district are so covered by thin Tertiary cappings and deep soil, that few observations can be made as to the character or inclination of the beds.

Soft earthy sandstones, from greenish-drab or brown to yellowish-white, and earthy or gritty shales, appear to be the prevailing forms. Imperfect plant impressions are numerous, and some distinctly recognisable forms have been obtained.

The area occupied by exposed Mesozoic rocks in the Cape Otway and Wormbete district, is bounded on the south-west and south-east by the coast line from the mouth of the Gellibrand River to between Loutitt Bay and Barwon Heads; and on the inland side, by flanking Tertiary deposits from the mouth of the Gellibrand to a few miles south of Colac, and thence round to the coast.

The Mesozoic rocks of the Barrabool Hills, near Geelong, and those exposed at Portarlington and Bellarine, are evidently continuous with one another, and with those of the Wormbete and Otway ranges, but are separated as surface outcrops by overlying Tertiary formations.

Like those of the Wannon, the Mesozoic rocks of the Otway and Geelong district consist principally of sandstones and shales, with occasional coarse gritty beds, composed of granitic detritus and fine conglomerates, containing pebbles of granite syenite, porphyry, metamorphic slate, and mica schist. At the Barrabool Hills the conglomerate beds contain pebbles of the underlying "diallage" rock in the vicinity, and Mr. C. S. Wilkinson also found in them pebbles of Silurian slate, containing well-preserved *graptolites*. The colours of the sandstones vary from nearly white to dark greenish-grey or yellowish-brown; the texture is generally soft and earthy, though sometimes hard, durable sandstones are met with.

The Mesozoic rocks of the Wannon, and of the Cape Otway ranges, are, in all probability, continuous with one another beneath the intervening Tertiary and volcanic tract, and it is also likely that they extend for a great distance inland beneath the volcanic plains reaching from Colac towards Skipton.

From Portarlington these rocks probably extend beneath the southern part of Port Phillip Bay, a small portion of their edge being visible on the eastern shore of the Bay near Mount Martha. That they do not extend to the north-east shore of Port Phillip is evident from the outcrops of the Silurian rocks at and around Melbourne and at St. Kilda, but it is possible that they may underlie the great plains between Williamstown and Station Peak, the southward extension of the Bacchus Marsh beds passing under, and being overlapped by, the northern extension of the Portarlington measures.

THE EASTERN MESOZOIC AREA, WESTERN PORT AND SOUTH GIPPSLAND.

The ridge formed by the Silurian rocks extending from Berwick to near Cranbourne, and by the Silurian and granite rocks between Port Phillip and Western Port, though planed down, and in places covered, by low-lying Tertiaries, separates the eastern from the western Mesozoic area, though it is possible that there may be a narrow connecting neck of Mesozoic rock beneath the Carrum and Koo-wee-rup swamps; the rocks of the two areas are, however, very probably continuous with one another beneath Bass's Straits.

Cape Woolamai, the south-east extremity of Phillip Island, consists of granite, while on the opposite eastern, or mainland, side the Mesozoic rocks appear in full development at Griffith's Point. The eastern passage of Western Port Bay thus forms the extreme western limit of the eastern Mesozoic area at the coast line. From Griffith's Point eastward the Mesozoic rocks form cliffs along the greater part of the coast line, as far as Anderson's Inlet, where recent sandy and alluvial deposits cover their line of contact with the Silurian rocks of Cape Liptrap. A line from between Anderson's Inlet and Cape Liptrap, over to the north of Foster, at the head of Corner Inlet, would indicate very nearly the boundary between the Silurian rocks on the south, and the Mesozoic on the north. The former disappear altogether a short distance east from Foster, while the latter have been proved to a considerable depth below sea-level in bores put down at various places between Foster and Port Albert. From Corner Inlet, north-eastward to Tom's Cap, the Mesozoic rocks constitute the prevailing rock-formation of the ranges, and slope coastward beneath the flanking Tertiary and Post-Tertiary accumulations forming the level country between Port Albert and Sale.

On the north, the valley of the Koo-wee-rup Swamp and the Lang Lang River, the valley of the Moe Swamp down to Moe, and thence the La Trobe Valley to the junction of the Morwell River, form the boundary between the granite and Silurian rocks on the north, and the Mesozoic rocks on the south—the actual line of contact is so far completely hidden by great accumulations of Tertiary and recent sedimentary and volcanic layers, which occupy the valleys and flank the slopes on either side.

From the junction of the Morwell and La Trobe rivers for a distance of about 10 miles easterly, and extending back several miles north of the La Trobe Valley, is a broad patch or tongue of Mesozoic rocks resting against the slopes of the Silurian. Of the northern line of contact of the two formations, good sections are visible in the Tyers River and Rintoul's Creek.

The widespread Tertiary and Post-Tertiary deposits of the La Trobe Valley and the Sale plains conceal the eastern limits of the Mesozoic rocks and their contact with the Upper Palæozoic rocks of the McAllister or other older formations. The

Mesozoic rocks between Western Port and Anderson's Inlet, and those eastward of Corner Inlet, extend beneath the sea, but to what distance cannot be ascertained.

Except a small outcrop of Silurian rocks at Turton's Creek, 10 miles north from Corner Inlet, the entire area within the above-described boundaries consists of Mesozoic rocks, more or less overlaid and flanked up to elevations of about 900 feet by Tertiary sedimentary deposits and volcanic layers.

The Mesozoic rocks of the eastern are geologically identical with those of the western Mesozoic area, and, generally speaking, the prevailing forms of rock are absolutely similar in the two groups.

At Griffith's Point there are layers of coarse and fine conglomerate, composed of granitic detritus, pebbles of quartz, quartzite, &c., and soft earthy breccio-conglomerates, made up of water-worn and angular fragments of somewhat hard, greenish mudstone.

Some of the sandstones between Griffith's Point and Kilcunda afford durable building stones, but, as a rule, the rocks are of a soft felspathic character, much jointed and faulted, the faults being sometimes accompanied by basalt dykes (not observed in the Otway district) and veins of carbonate of lime.

False bedding and frequent variations of dip and "rolls" in the strata are also observable.

North of the La Trobe Valley, along the Tyers River and in Rintoul's Creek, fine sections occur showing the contact of the Mesozoic with the Silurian rocks. The lowest beds of the former are coarse, thickly bedded, ferruginous, and siliceous conglomerates of quartz, quartzite, hard sandstone pebbles or boulders, and sand derived from the denudation of the Silurian rocks, and in some places 100 feet in thickness.

These conglomerates become finer in character towards the south, and are overlaid by thick-bedded sandstones, followed by alternating sandstones and shales, which in different varieties of colour, texture, and hardness, constitute the prevailing rocks of the series as developed north of the La Trobe, and in the South Gippsland ranges to the south of that river. The bedding in these tracts is more regular than in the Cape Patterson or Cape Otway districts ; the dip is nearly constant in a general south-easterly direction, at inclinations of from 7° to 25°. During the course of exploration of the South Gippsland ranges, I found that the south-easterly dip appeared to prevail from the extreme northern edge of the series between the Tyers and Rintoul's Creek, to the south-easternmost exposure of the Mesozoic rocks in Bruthen Creek on the fall towards the coast. This would indicate the very great thickness of over 20,000 feet, assuming an average rate of inclination not exceeding 10°, but it is possible that undulations in the strata may occur, or that the beds become more horizontal, between the points where dips were ascertainable, and thus necessitate a reduction in the estimate. Along the Narrican Creek, south from Moe, the strata are in some places nearly horizontal.

Only two species of fossil fauna have yet been discovered in the Victorian Mesozoic rocks—namely, *Unio Dacombi* (McCoy), found in the rocks of the Wannon, and *Unio Murrayi*, found in a piece of sandstone from Loutitt Bay. Both of these are fresh-water molluscs.

Petrified tree-stems and fragments of wood are very common, and throughout the series carbonized vegetable matter and plant impressions are frequent. Of the latter, the following species have been identified, and are figured and described in Decades Nos. I. and II. of Professor McCoy's Prodromus of Victorian Palæontology :—*Zamites (podozamites) Barklyi* (McCoy) ; *Zamites (podozamites) ellipticus* (McCoy) ; *Zamites longifolius* (McCoy ; *Tæniopteris Daintreei* (McCoy), and *Pecopteris Australis* (Mor)= *P. Scarburgensis* (Bean MSS.). *Sphenopteris* is also common. These are all characteristically of Mesozoic aspect. The three *Zamites* and the *Pecopteris*, are regarded as indicating the Oolitic epoch of the Mesozoic era, as that to which the Victorian carbonaceous rocks are most nearly referable. *Pecopteris* associated with these in Victoria has also been found in New South Wales and Tasmania associated with *Glossopteris Browniana*, common in the coal-bearing rocks of those colonies, but so far unknown in Victoria.

This has been regarded by eminent authority as evidence in favour of the Mesozoic age of the New South Wales coal measures, but, as has already been shown, the evidence as to their Palæozoic age is insuperable.

The palæontological evidence so far shows that *Pecopteris* is found associated with both *Glossopteris* and *Tæniopteris*, but that the two last named have never been found together; indicating that *Glossopteris* had become extinct before *Tæniopteris Daintreei* came into existence, but that *Pecopteris* outlived the former and flourished contemporaneously with the latter. The late Sir R. Daintree, in his work on the geology of Queensland, lays considerable stress on the non-association there of *Glossopteris* and *Tæniopteris Daintreei*, the former of which, that distinguished geologist considered to be indicative of the Palæozoic, and the latter of the Mesozoic age, of the rocks in which they are respectively found.

Between the Mesozoic and the Upper Devonian rocks of Victoria there is a great stratigraphical break, representing an epoch of which we have here no visible record in the shape of rock-formations, but which in New South Wales is filled up by the rocks of the carboniferous and permian series.

This period seems to have been occupied, as regards the area of the present land surface of Victoria, in the work of denudation.

After the completion of the Devonian strata, which appear to have been formed during the long-continued gradual submergence, an opposite movement set in, and the land rose again to as great a height above the sea, as it had been previous to the commencement of the Upper Palæozoic series.

This upward movement of the Victorian land may not have extended to the central eastern portion of Australia, and, if so, we may conjecture that during the period of emergence here, the northern portions of New South Wales may have continued depressed or were even still sinking. This would imply continued accumulation there, but loss of material here, and would account for the absence in Victoria, between the Upper Devonian and the Mesozoic groups, of any formation that can be referred to the age of the carboniferous rocks of New South Wales.

The only alternative surmise is, that rocks analogous to the last mentioned were once deposited in Victoria and were afterwards removed; it cannot be said that representatives of the New South Wales coal measures may not underlie portions of our Mesozoic and Tertiary areas, but, so far as can be seen, the Mesozoic rocks rest directly on Lower Palæozoic or older igneous rocks, and whatever intermediate formations may exist must lie concealed beneath the Mesozoic rocks in the deeper portions of the basins occupied by them.

Under any circumstances, there must have elapsed, after the close of the Upper Devonian period, and prior to the commencement of our Mesozoic formations, a long period during which denuding agencies were busy, and effected great changes on the rising land surface of Victoria.

When this rising movement had reached its greatest extent, the land surface was more elevated than now above the sea; the central mountain mass was of far greater altitude than at present above the contour of the present shore-line, as it had not, at that time, lost the materials of which it has since been denuded during Mesozoic and Tertiary times, and, notwithstanding the degradation experienced during the Upper Palæozoic period, still retained an alpine character, being then very probably many hundreds, if not thousands, of feet higher than at the present day.

With re-submergence, the deposit of the Mesozoic rocks commenced, and continued during long ages of gradual depression till a series of deposits had been formed skirting the main mountain system from the Wannon to Port Phillip and from Western Port to the Macallister, to a height not less than 2,500 feet above the present sea-level. This does not necessarily imply that every hill or spur of older rocks now under that altitude was then covered by the Mesozoic layers. The slopes of the main mountain system were then less denuded and more abrupt, and a contour line at 2,500 feet above that of the present coast-line would have been far nearer to the latter, measuring horizontally, than it is now.

The Silurian and granite outcrops of Cape Liptrap and Wilson's Promontory indicate the approximate position of portion of the central southern margin of the eastern Mesozoic basin, but it would be impossible, without more accurate knowledge of the geology of Tasmania and the islands in Bass' Straits, to form more than a conjecture as to the boundaries on the south-east and south-west.

There is nothing to show what formations were deposited on the north of the Main Divide during the Mesozoic period, unless the conglomerates of the Wild-duck Creek, near Heathcote, belong thereto. Any extensive deposits that may have existed have been removed, unless some remain concealed beneath the Tertiaries of the Murray Valley.

The conditions under which the Mesozoic rocks were formed do not appear to have been altogether marine, but rather fresh-water and brackish, merging into marine. The appearance of some of the layers which show false bedding; is strongly suggestive of their being sub-aërial or blown sand accumulations. The conglomerates at the edges of the Mesozoic areas speak plainly as to the vicinity of the land surface of the period to the localities where we now find them, while the character of the fossil flora and the few fossil fauna yet found tell the same tale.

We may regard the Mesozoic rocks as deposits, in great basins in the Palæozoic rocks, of sand, silt, mud, &c., conveyed from the land surface of the period, and arranged by comparatively shallow waters, whose currents were fluctuating both in direction and power. The land was in process of slow submergence, and, as it sank, the material derived from its waste continued to be arranged by marine or lacustrine action in layers of varying thickness, sometimes evenly, sometimes unevenly bedded, forming accumulations some thousands of feet in vertical thickness, the lower beds of which, in proximity to the land margin, took the form of conglomerates.

Intervals occurred during which the conditions were favorable to the accumulation, in swamps and shallow basins, of growing or drifted vegetation, subsequently covered by further layers of sand and silt, and altered to the form of coal. These processes went on until the submergence had attained its limits, and the land began to rise again. From this period commenced a denudation of the beds which had been deposited, and the erosion in them, and in older rocks, of new hollows or channels, which were destined in their turn to be again partly filled by the accumulations of the Tertiary epoch. Thus, the valleys of the Koo-wee-rup and Moe swamps, regarded by many, on account of their physical configuration, as likely places in which to search for coal, were in reality eroded along the junction of the Palæozoic and Mesozoic rocks, *after the completion of the latter*, and are less likely to contain good coal seams than the more central portions of the Mesozoic areas.

WESTERN PORT, CAPE PATTERSON, AND SOUTH GIPPSLAND COAL-FIELD.

The eastern carbonaceous area, or that including the Western Port, Cape Patterson, and South Gippsland districts, lying between the coast line on the south, and the Western Port, Koo-wee-rup, Moe, and La Trobe valleys on the north, is roughly some 2,500 to 3,000 square miles in extent, reckoning the parts where the measures are overlaid by Tertiary deposits, and is that in which the only really promising coal discoveries have yet been made in Victoria,.

Intermittent efforts have, from time to time, during the last 30 years, been made to develop these, but conflict of opinion among experts, misdirection of efforts at prospecting, want of funds and of faith just as favorable developments became likely, and, perhaps chiefly, the difficulties and expense attendant on providing the requisite means of transit, have all combined to retard progress, and a dividend-paying coal mine does not yet exist.

At the present time, however, more persistent and well-directed efforts are being made to trace the extent of the known coal seams: diamond-drills are at work in various districts; railways and projected lines of railway pass near or through the localities where some of the best seams occur, and the next five years may possibly witness the establishment of a new and important branch of mining in Victoria, and an addition of incalculable value to her industries.

It is true that many difficulties have to be overcome, that hopes now justified by known facts may be dissipated by the discoveries of others as yet unobserved. For the information, therefore, of those interested (and who among the settled population of Victoria is not?), it is well that a clear and distinct statement of our position as regards coal resources be given, omitting no fact, indication, or deduction, whether favorable or unfavorable.

Coal has been proved to exist in various localities throughout the area under notice; along its southern or coast boundary; along the northern or inland margin, and at several places in central portions.

Commencing at the coast line, and proceeding south-easterly from Griffith's Point, the following are the principal known coal seams:—

The Sandy Waterholes seams are exposed in cliff section on the coast about 5 miles from Griffith's Point, and are five in number, all within a total thickness of 50 feet. The two two middle ones, 2 feet apart, are each from 18 inches to 24 inches thick, the others being smaller; they dip inland, and it is stated that, in a shaft, now filled in, situated 100 yards back from the cliff, a seam was cut, which showed a thickness of 24 inches of coal.

Deteriorated as they are by exposure on the face of the cliff, it is difficult to pronounce with certainty on the quality of these seams, but it appears likely to be very good if they are followed in; and as their extension inland could be tested for a few hundred pounds, and they are within so short a distance of the shipping place, they are certainly worthy of exploration.

The Kilcunda seam has been worked in from the face of the cliff by means of an adit, and further inland from a shaft 100 feet deep; several "faults," one of which is a down-throw of 40 feet, dislocate this seam; but it has been followed from the shaft along its strike (about W. by N.) for more than 700 feet without a break. Some 5,000 tons of coal were raised and sent to Melbourne by a former company, and the present holders are vigorously developing the mine.

The quality of the coal is excellent; its thickness varies from 20 inches to 27 inches, or an average of barely 24 inches. The "holing" is hard, and necessitates some waste in cutting; but, nevertheless, men of long and varied experience maintain that means of transit alone are required to enable this seam to be worked at a profit. Its inclination is inland, somewhat E. of N. at 10°. Of several diamond-drill bores put down in the neighbourhood, one to the north of the mine proved a 20 to 24 inch seam at 165 feet; besides a number of small ones down to 873 feet. From another bore, on Bridge Creek, 3 miles east of the mine, a core showing 32 inches of coal was obtained at 490 feet, besides other smaller ones above and below that depth. Whether these two seams be one and the same with the Kilcunda seam, remains to be proved, but they are most important discoveries, indicating, as they do, the extension of the coal over a considerabe area, and the probable existence of many millions of tons within a short distance of the surface, and within convenient distance of a shipping place.

From the mouth of the Powlett River, 3 miles E. from Kilcunda, for a further distance of some 4 miles, nothing is to be seen of the rocks along the coast, but thence for 12 miles, by Coal Creek and Cape Patterson to within a short distance of Anderson's Inlet, they are visible the whole way, and afford excellent opportunities for observation.

At about the first exposure of rocks on the coast, travelling from the Powlett towards Coal Creek, there are three small seams, and further on a seam of about 10 inches of good coal with several feet of black "clod" beneath it; these are only visible at times when the tide is low and the sand temporarily removed. About this locality, it is stated that a seam of 20 inches was proved inland among the hummocks, but has since been obscured by blown sand.

A mile westerly from Coal Creek is a coal seam of from 20 to 24 inches between two smaller ones of 4 inches each, all dipping N.W. at 40°. This dip is exceptionally high and abnormal in direction, the rocks on both sides, for some distance, dipping from S.S.W. to S.S.E. at from 4° to 14°. In this locality, however, much disturbance, variation of dip, and false bedding, are visible in the strata.

Two or three other small seams occur between here and Coal Creek, west of the mouth of which are the two main seams, the "Rock" and the "Queen" veins. Where exposed on the coast, these seams dip W.S.W at about 30°, but in a shaft (known as Bury's or Davis's shaft) sunk through them a few chains inland, the inclination is only 15°.

The section in the shaft is as follows :—Measures (sandstones, shales, &c.), 57 feet. Upper coal seam—total thickness, roof to floor, 30 to 36 inches, with irregular partings, reducing the available thickness of coal to about 24 inches.

Measures with a small 4-inch seam, 11 feet. Lower coal seam—total thickness, 42 inches, divided by impure bands into three portions of 2½ to 3, 2½ to 3½, and 22 to 24 inches respectively. These measurements represent the general average, as no two sets of measurements taken, whether in different parts of the shaft, or on the coast outcrops, tally exactly, owing to variations in the thickness of the coal and partings.

On the whole, I would estimate an available thickness of 24 inches of coal to be the average for each seam as now visible.

Eastward of Coal Creek, between it and Cape Patterson, the basset edges of some thirteen distinct seams are visible in the rocks ; all have a S. to S.S.W dip at about 12°; the largest of these only is of workable size, and is from 20 to 24 inches thick; it was worked a short distance inland by the late Victoria Coal Company, about 20 years ago, and yielded 1,900 tons of coal before being abandoned on account of the difficulties of shipment. It appears also that where so worked the dip had changed to a north-easterly direction, and, though unable to verify by personal underground inspection, I am fully prepared to accept the statement, as the same change is visible in the rocks along the coast, which exhibit an unvarying north-easterly dip from Cape Patterson to near Anderson's Inlet.

About Coal Creek and Cape Patterson there are several large and small basalt dykes, which intersect the rocks, and will assuredly be found to locally affect and probably "fault" the coal seams.

The prevailing north-easterly dip of the ascending series of rocks, visible from Cape Patterson towards Anderson's Inlet, the more regular and even character of the layers, and the absence of dykes in that direction, are favorable indications that the large Cape Patterson seams passing beneath them, will be found to underlie a great area and to continue tolerably persistent and unbroken northward and north-eastward from Cape Patterson.

As pointed out long ago by Mr. A. R. C. Selwyn, the "Rock" and "Queen" veins at Coal Creek, are likely, from their south-westerly or seaward direction of dip in that locality, to outcrop inland, assuming such direction of dip to be maintained ; but, from observations of the dips of the rocks generally along the coast, it appears that the undulations of the beds are such that not only do they incline north-eastward from Cape Patterson, but also change their dip northerly from Coal Creek, and incline inland, as though to pass under the lower part of the Powlett Valley.

Indeed, the idea that the Sandy Water-holes seams are the western outcrops of the Cape Patterson seams, and that they underlie the Kilcunda seam, is not so far-fetched as may at first sight appear, but nevertheless the variable character and dip of the rock-layers, and the absence of any markedly distinctive rock bands, forbid the adoption of any special theory.

In the ascending series of beds visible from Cape Patterson to Anderson's Inlet, there occur a few small coal seams, but save one of from 10 to 20 inches, none that appear likely to become of importance.

At Foster, in the bed of Stockyard Creek, and close to the boundary of the Silurian rocks, is a coal seam which possibly may be worthy of more attention than has yet been bestowed upon it. The coal itself is of fair quality, and as far as followed it dips north-westerly in a succession of descending shelves, the thickness of which increases downwards from 10 to 20 inches. Further insight into the character of this seam could be obtained at very small expenditure.

Between Foster and Port Albert the measures were proved in bores to a considerable depth, and, it is stated, small seams of coal were discoverd more than twenty years ago.

Along the northern portion of the carbonaceous area there are on the Bass River and in the adjacent ranges several outcrops of coal seams up to 20 inches in thickness, some of which have not yet received much attention. In the head of the Bear Creek, a main branch of the Moe, is a seam (described in Progress Report No. III. as O'Maloney's seam) of excellent coal, though only 9 to 11 inches thick ; this seam dips south-easterly at 32° (an abnormally high angle, not likely to be maintained far), and, as it shows signs of increase on its dip, is worthy of further trial.

In the extreme north of the carbonaceous area on Rintoul's Creek, 8 miles north of Traralgon, is a seam of bituminous shale 10 inches thick, which yields a good illuminating oil, and burns well, but leaves a strong residue of undiminished bulk. This exposure is only the edge of the layer, as the Silurian rocks appear a short distance up the creek ; it dips south-easterly, and is very likely to increase in thickness in that direction.

The Hazelwood seam outcrops on a branch of Billy's Creek, 8 miles S.S.E. from Morwell.

In the width of a heading driven along it for a distance of 18 feet, the coal increases from 20 to 28 inches, with indications of still further increase on its dip, which is to the S.E. at 27° (a high rate of inclination, not likely to continue far). The coal, as far as proved, is soft, but burns well, caking and blistering strongly, and appears likely to yield a very good coke.

The Moe coal seam is one of the most promising in Victoria ; there are two exposures, about 2½ miles apart, and, though not a matter of absolute certainty, these appear to be different outcrops of the same seam. The western outcrop is at the head of Mosquito Creek, 4 miles S.W. from Moe, on the fall towards the Moe Swamp. Though some tunnelling and sinking has been done on the exposure, the seam has not yet been fairly traced beneath its proper roof.

Of the total thickness of from 24 to 28 inches, the lower 16 inches only is good coal as far as proved, but there is likely to be an improvement when traced beneath the proper roof, which could easily be done ; this seam rests on a clay floor. The eastern exposure, in Messrs. Stephenson's selections, is in the head of a gully running into the northern tributary of the Narrican ; here the coal has been followed from its outcrop beneath its proper roof, and shows in the tunnel-face a thickness of from 30 to 32 inches of first-class coal with only one thin insignificant clay parting ; it rests on a clay shale floor, and is covered by a thick sandstone roof. The dip is southerly at about 10°, a direction and rate of inclination which, if continuous, as appears likely, will carry the seam well under the Narrican Valley, where other exposures of coal, as yet untested, are visible.

This seam is now undergoing exploration, and on the results thereof—so far, most encouraging—may be said in a great degree to depend the coal-mining future of the district.

In the central portion of the area, on or adjacent to a line from Moe to Cape Patterson, are several coal outcrops, the most important of which is the Strzlecki seam, about 14 miles north from Anderson's Inlet.

There are two outcrops less than 2 miles apart, but whether of the same or of different seams is uncertain. The northern exposure is on a western tributary of the Tarwin, near the divide between that river and the Powlett.

In a cutting recently made, there is exposed, in a height of 7 feet, an aggregate thickness of 3 feet of good coal, in three separate seams of 12 inches, 8 inches, and 24 inches respectively, the lower 18 inches of the latter, or undermost seam, being very good indeed.

The southern outcrop is in a gully trending to the Powlett, and here a short tunnel has revealed the existence of a seam (dislocated to the extent of 3 feet in one place by a "fault") containing, at the face of the tunnel, an unbroken thickness of from 30 to 32 inches of excellent coking coal.

Whether the same, or different seams, there is good reason to believe that the coal exposed in these two outcrops underlies a great area, and the discoveries made by means of so small an amount of labour, amply justify further research.

In the heads of the Tarwin, between the Strzlecki seam and Moe, are several other outcrops, some of which show as much as 16 inches of good coal; but none of these, so far as I am aware, have been in any way tested as to their extent.[*]

The foregoing enumeration and description of the known coal seams will sufficiently show that there are just grounds on which to base the hope that Victoria may yet produce sufficient coal for her own consumption ; at the same time, it is only right to lay before the public, a clear statement of the evidences, favorable and unfavorable, and the reasoning based on those evidences.

Favorable.

The carbonaceous rocks of Victoria are well within the range of geological groups, among which, in various places throughout the world, payable workable coal seams occur.

Coal seams occur in these rocks, throughout the whole of the eastern carbonaceous area, and some of these are of a thickness, which in other coal-producing countries, even in Great Britain, is deemed a workable size, provided the quality be good and the working conditions favorable. The thickness here assumed as the workable minimum under most favorable circumstances is 16 inches of marketable coal in one seam ; we possess some seams from that thickness up to 32 inches of solid coal, and others yielding an equal aggregate, but divided by impure layers.

Of our known coal seams, the quality, almost without exception, has been proved by analysis and experiment to be excellent; it is more splintery and suffers more loss in carriage than the New South Wales coal, but is, as a rule, superior to the latter for steam, forge, and household purposes.

There are evidences to show the likelihood that our known seams, even if they be but patches, are nevertheless patches of extent considerable enough to admit of their being profitably wrought, and, in addition, there is no reason for supposing that the known outcrops, due as they are to removal, by denudation, of overlying strata, have all been laid bare at the best part of the seams they belong to. Lastly, there are, in the Victorian carbonaceous series, layers which do not appear at all, or whose extreme edges only are to be seen at the surface.

Among these, there exists the possibility, as pointed out long ago by Mr. A. R. C. Selwyn, of finding coal seams larger and more valuable than any of those known.

Unfavorable.

There are certain features in connexion with the carbonaceous rocks of Victoria which demand consideration, as warnings against too sanguine hopes for the future as regards coal mining.

Though thick and regular rock-layers are not wanting, many of the beds show in their structure indications of having been deposited under changeable conditions; frequent variations in texture and alterations in character are noticeable in some of the bands ; false bedding is very common ; certain layers becomed attenuated, or are replaced by wedge-shaped bands of different character. The small coal seams, so frequent in the rocks and visible in cliff sections along the coast, are seen, after continuing solid for various lengths, to split up into thin carbonaceous laminæ, which finally thin out and disappear. Generally speaking, only in a few localities, so far as yet observed, do the rocks show signs of having been deposited under equable conditions, extending over large areas for long periods.

The cores of rock obtained during boring with the diamond-drill at Kilcunda show, to a depth of 1,000 feet, unmistakable signs of false bedding in various layers, indicating fluctuating conditions as having been present during their formation.

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[*] There has recently been discovered on Berry's Creek, a branch of the Tarwin, in the parish of Mardan, a seam of coal which at 43 feet from surface shows a thickness of 4ft. 8in. ; the coal is good, though one analysis gave a high percentage of ash.

The fact that coal exists, is in itself full evidence that during the formation of the carbonaceous rocks the requisite class of vegetation flourished from time to time, but we cannot yet be sure that it had the opportunities afforded by long periods of quiescence to accumulate in sufficient quantity, and over sufficiently large areas, to form really large and extensive seams.

We have not therefore yet any guarantee that any known seam maintains its workable character over a single square mile, however good reasons there may be for believing such to be the case.*

The faults, the "rolls," the alterations and frequently high inclination of dip, and in many cases the long distance of land carriage, together with the competition of New South Wales, favored as she is in the possession of large easily worked seams, and exceptional water-carriage facilities, will always heavily handicap Victorian coal mining.

General Remarks.

Having, without prejudice, shown both sides of the question, knowing well the difficulties in the way, and being fully aware that the opinion here expressed is at variance with that of very eminent authorities, I still venture to assert that we possess in Victoria coal resources from which we will ultimately supply our own wants, at less cost than by importation from elsewhere.

All that now remains to be done is to trace out and prove the extent of our known seams, and to apply a few conclusive tests to ascertain the existence or non-existence of others that may be concealed.

The very character of the rocks shows that, though the coal in some directions may be found to thin out, in others it is equally likely to increase; but, accepting as constant the exposed thicknesses of coal in the known seams of 20 inches and upwards, there is sufficient inducement to carry out most exhaustive investigations as to their extent. Much can be done, by means of surface cuttings, tunnels, and shallow holes, to trace the known seams for considerable distances from their present exposures, and in this work the principle should be adhered to of not going too far away from any outcrop of a seam at first, but to follow it patiently step by step, cutting it at short intervals, until a thorough knowledge of its peculiarities and an assurance of its permanence over a large area be obtained, when exploration further afield will be warrantable. These remarks apply particularly to the Moe and Strzlecki seams, where the natural configuration of the country specially favours the kind of work suggested, which, though apparently cautious to excess, is nevertheless advisable in the first stages, on account of the liability of the strata, and their contained coal seams, to displacement by faults and variations in dip.

As regards deep exploration, there appears no reason to alter the opinions already published as to the most suitable localities for boring.

The diamond-drill has already done good service at Kilcunda and eastward; deep bores at properly selected sites near Cape Patterson, in the vicinity of the Strzelecki seam, and in the Narrican Valley, will enable the extensions of known seams, and also a great subjacent thickness of concealed and unknown strata, to be tested in localities where the surface rocks show the greatest indications of permanence and regularity; and the results of such bores will decide, whether we will have to be wholly dependent on known seams, or whether there are other concealed ones from which supplies may be drawn. Even should the former prove to be the case, there is still the probability that the known seams are of sufficient extent, and that economical mining, and facilities for transit, are the main requirements in working them to advantage.

On the Kilcunda seam, which only averages barely 24 inches, and where there is waste and difficulty in "holing," owing to the hardness of the floor, good miners can make fair wages at 7s. per ton for screened coal, finding their own powder, fuse, and candles, doing their own filling and timbering, and making their own roads from the main heading.

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* See Addendum, of later date (page 90).

Cost of haulage, management, interest on value of plant, &c., increase the cost to the proprietors, but with a full complement of men at work, and allowing for the value of the "slack," I do not think the total cost will exceed 8s. 6d. per ton at grass, after which carriage to market, loss in transit, and incidental expenses should not, with a regular output of coal and proper means of transport, add more than 6s. 6d. to the cost, making a total of 15s. per ton in Melbourne.

THE WESTERN CARBONACEOUS AREA.

The carbonaceous rocks of Bellarine, the Barrabool Hills, the Wormbete and Otway ranges, and the Wannon, are absolutely indentical in geological position and lithological character with those of the eastern area; but though the existence of workable coal seams is geologically as likely in one as in the other, such discovery has not yet been made in the western area.

Seams of inferior coal occur at Coleraine; a small seam of a few inches, and another reported to contain 20 inches of good coal, occur near Apollo Bay; also other small and impure seams near Loutitt Bay. A 6-inch seam of very good coal has been proved a few miles south from Colac, another near Winchelsea, and a few in the Geelong district.

None of these unfortunately appear likely to develop into large workable seams, and the only hope of success therefore in the Western district lies in piercing the concealed strata. It is geologically possible that large seams may occur, but actual experiment alone can prove it. A group of rocks may be all that is required in geological position and general character, but they may yet contain no coal, simply because, during their deposit, no interval occurred in which the necessary conditions for coal-formation were present, while in another locality during the same period such conditions were fully developed.

The boring operations now in progress in the Western district are fully justified by the rock indications, but are still purely tentative in character.

The bores now going down in the Wannon district ought fully to set the question at rest there; the bore at Portarlington, if carried down for 1,000 feet, will fully test the Geelong district; these, with one at Colac, and another near Winchelsea, ought to furnish conclusive evidence. The last-named site, in particular, presents most favorable conditions, the strata being nearly horizontal, and very evenly bedded, so that if a coal seam be found, it ought to be regular and extensive.

REGINALD A. F. MURRAY,
Geological Surveyor.

January 6th, 1883.

ADDENDUM TO GENERAL REPORT.

CARBONACEOUS ROCKS OF VICTORIA.

Since the foregoing general report was published in the newspapers, a considerable amount of work has been accomplished in searching for coal seams and in exploring further the known ones. In the Western district, at the joint expense of the Government and of the inhabitants of various localities, a number of bores have been put down to pierce and test the concealed layers of the Mesozoic rocks.

The few small seams that have been actually proved to exist in the rocks of the western Mesozoic areas, and the geological identity of those rocks with the similar strata of Western Port and South Gippsland, in which workable coal does occur, justified the expenditure, though it was pointed out beforehand that only the possible existence of coal could be indicated, and that, though the rocks in which coal might occur were there, the coal itself might be absent.

Nothing but actual experiment could, however, solve this question, and though it is to be regretted that the borings made have so far proved unsuccessful, the negative results obtained are valuable as safeguards against further fruitless expenditure, and in satisfying the public mind on the subject.

The bores at Coleraine and Colac pierced no other than the unworkably small seams already known to exist. The bore at Portarlington—the site of which was specially chosen on account of its position in the centre of a bight in the western Mesozoic basin—was carried down to the great depth of over 1,500 feet without piercing a single coal seam, though plant impressions and small layers of coaly matter were met with at intervals the whole way down.

The diamond-drill is now at work near Winchelsea, at a site specially selected on account of its central position in the Mesozoic area, the known existence of a small coal seam in the vicinity, and the regular and horizontal stratification of the rock-layers; it has been recommended that this bore, as a final test, in the most promising locality, be carried on as far as it is possible to pierce with the diamond-drill, and should no coal be found, all hopes of a workable coal seam in the Western district may be abandoned.

In the Mesozoic area east of Port Phillip, the development of coal mining presents a far more promising aspect, and is beginning to justify the hopes expressed in the preceding general report.

The Western Port Coal Company have followed the Kilcunda seam (averaging 2 feet of excellent coal) for more than 1,000 feet on its strike, without a break, and have also followed it down its underlay for a considerable distance without finding a sign of disturbance, diminution in average thickness, or deterioration in quality. By the time this appears in print, Victorian coal from the Kilcunda mine will probably be upon the market, the company having at the present time completed their railway to the shipping place, and other necessary works.

At Cape Patterson, Mr. N. Levi has sunk a shaft, and cut the coal seam worked many years ago by the Victoria Coal Company—on the inland side of a disturbing fault—and though the available thickness of workable coal, so far as exposed, is rather small, the quality is most excellent, and the total thickness of the seam is about 2ft. 6in., including impurities, which may be expected to disappear as the seam is traced inland, where the geological indications warrant the belief that it will extend beneath a great area.

The diamond-drill bores near Kilcunda, at the Bridge Creek, and at the Powlett River, 7 miles eastward of Kilcunda, have satisfactorily established as a fact, that the coal seams are not mere patches.

The value of the information obtained by means of the last-mentioned bore, as to the existence of two workable seams of good coal, at easily accessible depths, and in nearly horizontal strata, may in itself be regarded as an equivalent for all the expenditure on diamond-drills since their introduction into the colony. The statement made in the general report—that we had, at the time that report was written, no guarantee as to the continuance of any known coal seam beneath a single square mile—may now be withdrawn. We have now evidence of their continuance beneath many square miles.

The Strzelecki and Coal Creek companies, whose holdings adjoin one another about 13 miles south from Poowong, and 14 miles north from Anderson's Inlet, possess workable coal seams of good quality, and means of transit is, in their case, the sole requirement to success.

The surveyed line of the Great Southern Railway passes the tunnel entrance of one of these companies, and, should the line be constructed, there is nothing to prevent the coal being mined at a minimum of expense, trucked from the mine into the railway freight-cars, and conveyed to any part of the colony accessible by rail without further handling.

The Moe Coal Company, towards the northern margin of the Mesozoic area, have been steadily and carefully testing the extent of the seam which outcrops in their ground.

From the outcrop, in a southerly direction for a distance of about half-a-mile, bores have been put down at short intervals, and have in each case proved the continuance of the seam, and the maintenance of its workable thickness and quality. A shaft has been sunk near the southernmost bore, and has cut the coal, which shows an unbroken average thickness of 27 inches. An adit is now being driven, which will meet the coal in 300 feet, and from that point of intersection there will be at least half-a-mile up the incline of the seam, and probably 2 miles along its strike, to be worked from the adit without expenditure for winding or pumping machinery. Taking an average of 2 feet of coal, this gives over 2,000,000 tons available from the adit, and deliverable within a few hundred yards at the Narrican Valley Railway, whenever that line be constructed.

A diamond-drill is now at work in the Narrican Valley, and has struck, at 117 feet, a 30-inch seam, which I believe to be the southern extension of the abovementioned coal seam, though at a shallower depth than I had reason to expect. The bore is being carried down further in search of any other seams that may exist below.

The main cause for doubt as to the coal from the small-sized Victorian seams being mined at a profit consists in the fact, that all coal produced in Victoria must be conveyed a greater or less distance by railway, and it is possible that the cheaply mined coal from the large seams of New South Wales, conveyed by water carriage from the mines to Melbourne, can be placed on the market at a price which would not pay the Victorian coal miner. Against this may be set the higher value of the Victorian coal for steam and household purposes, and the power that could be exercised by the State—without resorting to extreme protective measures—of fostering the industry by conveying the product at a nominal rate from the mines to Melbourne, along such railway lines as now exist or may hereafter be constructed. This would probably be found to work better than either imposing a duty on imported coal or giving a direct bonus for that produced in Victoria.

REGINALD A. F. MURRAY,
Geological Surveyor.

26th November, 1883.

SECTION III.

REPORTS RELATING TO THE PROBABLE DISCOVERY OF ARTESIAN WATERS BY MEANS OF BORING IN CERTAIN LOCALITIES.

Prefatory Remarks.

The great success attending the boring operations in search of artesian waters at Sale, in Gippsland, and the important influence that similar discoveries would exercise on the fortunes of those inhabiting the arid portions of the colony, have led to many applications from the residents in different parts of the country for advice on the subject.

As in the case of prospecting for coal, gold, &c., there are many instances in which the geologist can unhesitatingly say of a locality, that search there for artesian waters would be useless, and so deter the public from needless outlay.

In other instances, the probable existence of artesian waters, within a certain area, can be inferred from the geological and physical conditions, but the actual locality can only be discovered by means of experiment.

In the cases of some of the localities reported on as presenting encouraging indications, no further steps appear to have been taken to test the question, but in the northern and north-western areas a considerable amount of boring has been carried on, and in many places the bores have tapped good water, though not under pressure sufficient to cause it to rise to the surface. There is, nevertheless, ample ground for the confident belief that, beneath the level tracts of the North-western district, between the Grampians and the Murray River, there are copious supplies of water, which will rise to the surface when tapped; but owing to the probability that such water may occur only within narrow zones, and to the absence of any surface indications of their presence, they can only be expected to be found by means of long-continued patient exploration.

GEOLOGICAL SURVEYOR'S REPORT RESPECTING BORING FOR AN ARTESIAN WELL AT BRIGHTON.

SIR, Office of Mines, Melbourne, July 4th, 1881.

I have the honour to report that, in accordance with your instructions, I visited Brighton on the 1st instant, and had an interview with Mr. E. Lucas, Town Clerk, on the subject of boring for an artesian well in that locality.

Judging from the geology of the country, with which I am tolerably well acquainted, and the fact that artesian water was struck a number of years ago in a bore between Brighton and Frankston, I consider that, although rather close to one edge of the Tertiary basin, there is, nevertheless, sufficient probability of artesian water being found near Brighton, to justify boring in search of it.

The places at which it is proposed to bore are—the highest point in Bay-street, and a ridge a short distance to the soutward thereof ; these are proposed as the most suitable points whence to distribute the water should an artesian well be found. As the trifling surface undulations around Brighton are not of the slightest value as indications where to search for water, I see no reason to suggest any other choice of sites.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

MEMORANDUM. Office of Mines, Melbourne, 9th July, 1881.

The sketch-section, and the following notes, are furnished in compliance with Major Couchman's desire that I should further illustrate my report as to the probability of discovering artesian waters by boring at Brighton.

REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

NOTES *re* BORING FOR ARTESIAN WELLS NEAR BRIGHTON.

MEMORANDUM. Office of Mines, Melbourne, July 5th, 1881.

The following notes are submitted as an addendum to my report of yesterday relative to the proposed boring operations at Brighton in search of an artesian well.

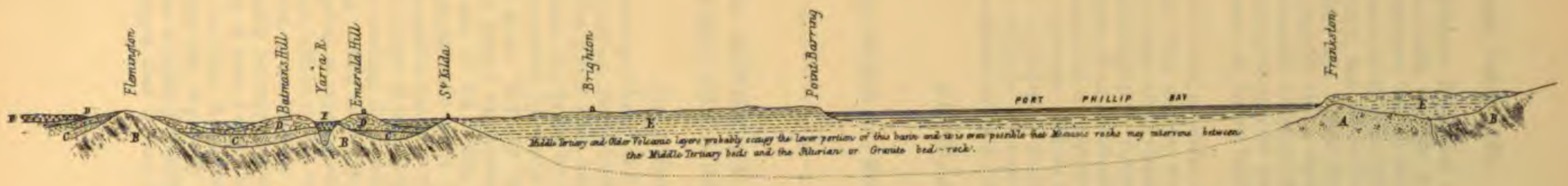
The Tertiary area on which Brighton is situated lies between the exposed Silurian rocks at St. Kilda and those near Frankston. Inland from between St. Kilda and Frankston, the Tertiary formations extend into Gippsland, and occupy a depression between the granite and Silurian rocks of Buneep, Pakenham, Berwick, and Dandenong on one side, and the Mesozoic rocks of Western Port and South Gippsland on the other.

The boundary primary rocks nearest to Brighton are the Silurian rocks exposed at St Kilda and extending thence round to the north of Oakleigh. With numerous undulations, the Tertiaries extend from Hobson's Bay up to near Mount Macedon, and to Bacchus Marsh, and also occupy a considerable extent of country on the west of Port Phillip. On the coast line, the limits of this great Tertiary

Geological sketch section from Flemington by Emerald Hill, St. Kilda & Brighton to Frankston.

Scale

Horizontal 4 miles } *to an inch*
Vertical 800 feet }


Flemington
Batman's Hill
Yarra R.
Emerald Hill
St. Kilda
Brighton
Point Barring
PORT PHILLIP BAY
Frankston
A
B
C
D
E
F
Middle Tertiary and Older Volcanic layers probably occupy the lower portion of this basin and it is even possible that Mesozoic rocks may intervene between the Middle Tertiary beds and the Silurian or Granite bed-rock.

A Granite. B Silurian. C Middle Tertiary beds. D Older Volcanic. E Upper Tertiary beds. F Newer Volcanic.

NOTE.—The Middle Tertiary and Older Volcanic layers N.W. from Flemington and between Flemington and St. Kilda, and the similar formations of Berwick and Cranbourne, in all probability extend beneath the Upper Tertiary deposits between St. Kilda and Frankston. It is in piercing the Middle Tertiary strata that I think lies the greatest chance of the success of any boring operations for artesian wells near Brighton. Should these Middle Tertiary beds underlie the Upper Tertiaries of Brighton, and contain permeable layers covered by impervious beds which flank the edges of the Silurian basin, and so prevent the escape of the water laterally, besides extending inland the elevations above Brighton, then artesian water is likely to be found; but if, on the other hand, there is any ready means of escape for the subterranean waters either seaward or at low elevations along the edges of the basin, the requisite pressure to make water come to the surface at Brighton cannot exist. Actual experiment alone can determine this matter.

area are the Mesozoic rocks of Western Port, and the granite of Cape Woolamai on the east, and the Mesozoic rocks towards Loutitt Bay on the west, the granite and Silurian rocks of Frankston and Dromana forming an insular mass between. These Tertiary formations consist principally of clays, calcareous beds, and volcanic layers of Middle Tertiary, and sandy ferruginous beds, clays, gravels, and volcanic layers of Upper Tertiary age. Extending so far inland and flanking the older rocks to elevations considerably above that of Brighton; embracing so large a soakage area, and being also largely composed of permeable layers; this great Tertiary basin presents the conditions necessary to the existence of artesian waters, of which a discovery was actually made, in boring between Brighton and Frankston, a number of years ago.

Such wells, however, will only be found at places underlaid by permeable strata, through which the water percolates from sources above the level of those places, and which are overlaid by beds of an impervious character, which prevent the water from rising to its natural level unless tapped by means of bores or wells.

As to the existence of such places, there are absolutely no surface indications to serve as guides in the Brighton district, and, consequently, any boring operations there must necessarily be of a tentative character. There appears, however, a reasonable hope that water struck there may be subject to the requisite pressure to cause it to rise to the surface. The nearest Silurian outcrops are several miles distant, and there are the chances of pressure originating from more distant localities around the margin of the Tertiary basin.

REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

GEOLOGICAL SURVEYOR'S REPORT ON THE SUBJECT OF BORING FOR WATER NEAR THE ALBERT PARK LAKE.

SIR, Camp-street, Talbot, July 30th, 1881.

In accordance with your instructions, I have the honour to submit, for the information of the Emerald Hill Town Council, the following remarks on the subject of boring in search of water near the Albert Park Lake.

As shown on the geological map, the formation of Emerald Hill is that classed as older volcanic, and it is surrounded by sandy and alluvial deposits of more recent date; it is within the great Tertiary basin of Port Phillip, but not very far from one edge of that basin; the containing Upper Silurian bed-rock being visible on the Melbourne side of the Yarra, along Flinders-street eastward from Elizabeth-street, at the barracks, and at St. Kilda. There is, nevertheless, a sufficient distance between the nearest exposure of bed-rock and the north-western shore of the Albert Park Lake to allow of a great thickness of Tertiary formations being met with in boring before reaching the bed-rock, though what that thickness may be, and the character of the strata, is purely a matter of surmise at present. In the bed-rock itself, it is hopeless to expect a sufficiency of water, so that, if it be struck at a shallow depth, there will be no use in proceeding further; but should there be, as I believe is the case, a considerable thickness of the older volcanic rock, and also of subjacent deposits between it and the bed-rock, then, in some of those layers, there is a likelihood of there being a large amount of water.

It is necessary to point out, however, that, though not impossible, there is very little evidence to justify the hope that any water so encountered will rise to the surface. It is true that the older volcanic formation extends for miles to the north-westward, and there is the chance that it may be underlaid at Emerald Hill by formations containing water, which has percolated from distant and more elevated sources through permeable drifts, overlaid by impervious layers; but it is only right to point out that the probabilities of this being the case are somewhat remote.

At the same time, if there be no other available means of replenishing the lake, and the Emerald Hill Town Council are prepared to risk the expenditure for boring (which should not be very heavy), I consider it worth while making the trial at the locality above indicated—the north-western shore of the lake near the railway line.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

Memo. for the Secretary for Mines, Melbourne.

38 Selborne Chambers, Melbourne, Oct. 21st, 1882.

Will you be so good as to obtain the opinion of the Government Geologist as to the probability or otherwise of obtaining water by boring on Phillip Island, and, if so, whether the northern part of Cowes would be a likely site for a bore, and oblige

A. PURCHAS, C.E.

The basalt of which Phillip Island is composed is portion of a great volcanic sheet, covering an ancient channel or trough in the older rocks. This channel receives the underground drainage of the country as far east as Drouin, and Cowes, on Phillip Island, is situated over about the middle of its probable seaward course.

Fresh water is likely to be found in the lower layers, or in drifts lying beneath the volcanic rock, and the general evidences indicate the possibility of such water being found under sufficient pressure to cause it to rise to the surface when tapped by means of boring.

I consider that the contemplated experiment would be justified by the general geological conditions.

REGINALD A. F. MURRAY,
2/11/82. Geological Surveyor.

ARTESIAN WELL-BORING IN THE WIMMERA DISTRICT.

Geological Surveyor's Report.

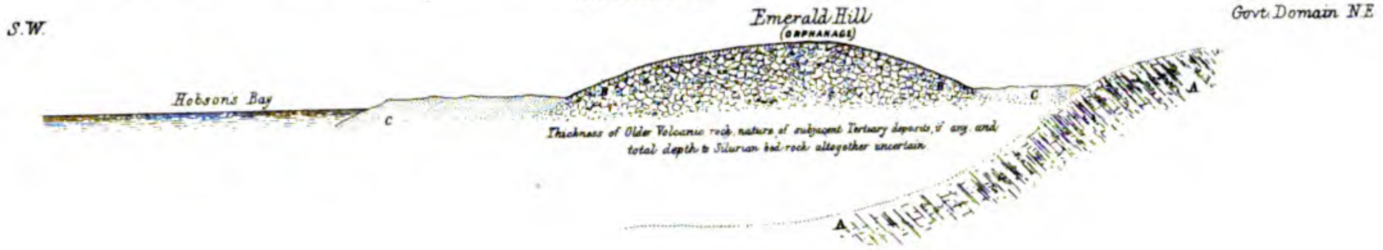
Sir, Camp-street, Talbot, March 22nd, 1882.

On the above subject, I have the honour to submit the following remarks, the outcome of careful consideration, based on an intimate knowledge of the geology of the Victorian portion of the Murray River Valley, on reliable information respecting the northern or New South Wales portion, and on observations made during personal inspection, recently authorized by you, of portion of the South Australian territory, between the boundary line and the sea-coast, and also on the north-western side of the Murray Valley.

SECTIONS

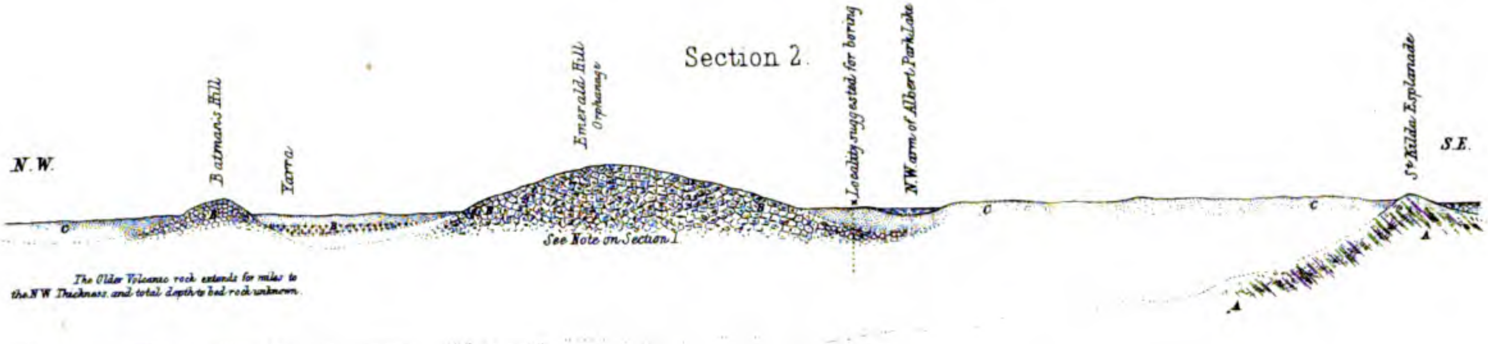
Showing what is known of the Geology of Emerald Hill and surrounding country

Section 1.



Thickness of Older Volcanic rock, nature of subjacent Tertiary deposits, if any, and total depth to Silurian bed-rock altogether uncertain.

Section 2.



The Older Volcanic rock extends for miles to the N.W. Thickness and total depth to bed-rock unknown.

(A) Upper Silurian bed-rock ▨ *(B) Volcanic* {*Older* / *Newer* *(C) Recent deposits*

Horizontal Scale 40 Chains to 1 inch.

Viewed geologically, the Murray drainage area, as a whole, consists of a great irregularly-shaped basin, hollowed in the Palæozoic schistose rocks and granites which compose its bottom and edges, and partly filled with newer accumulations, the latest of which constitute the surface formation, over by far the greater portion of the area.

The entire drainage area embraces a vast extent of country reaching back into Queensland, and receiving the waters falling westward of the eastern coast range of Australia, for a length of about 1,000 miles.

The primary bed-rock, whether Silurian, metamorphic, or granite, outcrops along the southern and eastern margins of the basin, from Casterton and Harrow, in the Western district of Victoria, to Queensland. The north-western and western margin appears in the Palæozoic rocks forming the ranges between the mouth of the Murray and Adelaide, and stretching far to the north-eastward into central Australia.

The newer formations which fill in the trough are various in character—a few are known, the rest are concealed. Cretaceous or Upper Mesozoic rocks overlie the Palæozoic rocks towards the upper waters of the Darling River, while Miocene or Middle Tertiary formations appear to extend at or near the surface the entire way, across from Casterton to the Murray. How far the cretaceous rocks extend down and the Miocene rocks up, the Murray Valley, can only be conjectured, owing to their being covered by Upper Tertiary and Post-Tertiary accumulations, nor can more than a guess be hazarded, as to what layers may underlie these in the central portions of the basin, until actual experiment solves the problem.

It is sufficient for the purposes of this report to point out, that the containing primary bed-rock of the whole basin is practically impervious to the escape of water in large quantity ; that in all the newer formations there are likely to exist permeable or cavernous beds, through which water can readily percolate ; and that it is in these newer formations that search for artesian wells is likely to prove successful, provided other necessary conditions are present.

The total depth of these newer formations is altogether uncertain, but it is not improbable that, in the central portions of the basin, there may be 2,000 feet or more of Post-Tertiary, Tertiary, and Mesozoic, or even perhaps Upper Palæozoic (? carboniferous) layers, before reaching the bed-rock.

The basin has but one outlet, at any rate so far as the Victorian and New South Wales portions are concerned. The portals of that outlet are, on one side, the Palæozoic metamorphic schists forming the base of the Grampians in Victoria, and on the other, the similar rocks on the South Australian side of the Murray, which constitute the Mount Lofty and Mount Barker ranges, and extend north-easterly into the interior. The Wimmera country includes nearly the whole width between these portals, as the Palæozoic rocks appear not many miles distant from the Murray on the South Australian side.

During my recent inspection in the South Australian territory, I observed an outcrop of granite on the coast 12 miles north from Lacepede Bay, and was informed that several similar isolated outcrops occurred, forming a broken chain connecting this with the Palæozoic rocks west of the Murray.

These occurrences appear to narrow the limits between which the underground waters of the Murray basin escape seaward, and to show that the bulk of those waters must necessarily pass beneath the Wimmera district.

Allowing for evaporation and escape by the main river, the quantity of water that passes away underground must be very great. It is only necessary to consider the great tropical rainfall in the north, the rapidly absorbing nature of the soil over vast tracts, and the numerous perennial rivers from the Australian Alps, which begin to lose their water by soakage as soon as they leave the mountains, to feel assured that a very large percentage of the entire rainfall makes its way underground to the ocean, and it is not an extravagant estimate, that the water so percolating beneath the Wimmera country is equal to, if not greater than, that escaping by the Murray River itself.

It would appear that the principal portion of the coast line, along which the subterranean waters pass out to the sea, is that between Lacepede Bay and the mouth of the Glenelg. Several very powerful springs from subterranean sources discharge constant streams at various points along the coast. The Blue Lake, at Mount Gambia, 700 feet in depth, appears to have never varied more than a very few feet, and yet the catchment area of the lake but very slightly exceeds that of its water surface. Fresh water can be obtained almost anywhere by sinking in the limestones from Gambier up to Border Town. In the railway ballast pits, near Narracoorte, water was obtained at a few feet, and could not be reduced by means of pumping. I was further informed that, in some of the subterranean waters in caverns in the limestones, a distinct flow from the north-east can be observed. Between Apsley and the South Australian border, I saw several depressions, apparently sink-holes connected with caverns in the limestone beneath, and learned that, though narrow, they are funnel-shaped and very deep; these contained water, and were they not fed by underground supply would assuredly be now dried up. The limestones observed appear to be all of Miocene or Middle Tertiary age, and to be highly cavernous—an indication of percolation by flowing waters—and they evidently extend under newer deposits a long distance into Victoria.

From a report to the Government of New South Wales, by Mr. H. Y. L. Brown, F.G.S., it appears that good supplies of fresh water have been obtained in various places in the Mount Poole district, by sinking or boring into or through the cretaceous rocks which there overlie the Silurian strata; Mr. Brown instances:—(1.) Wee-watta well, "a continously flowing spring of warm water discharging from a pipe sunk 144 feet in depth and rising 3 feet above the surface, at the rate of 7,000 or 8,000 gallons per diem." (2.) Mullyeo well, "also a continously flowing well, the water rising from a bore sunk 44 feet, and overflowing from a tank 4 feet above the surface at the rate of 12,000 or 13,000 gallons per day. It appears that the discharges from these wells were respectively 60,000 and 20,000 gallons per day, the decrease being due to deposits of mud, &c., lining and reducing the size of the pipes." (3.) Mount Wilson well "has a total depth of 480 feet, at which depth a strong supply of fresh water was struck, rising to within 90 feet of the surface. The cretaceous clay and shale were met with at 100 feet from the surface"*

During my recent inspection, I visited a bore being put down by the Salt Creek Petroleum Company, at a site situate about 8 miles inland from the Coorong, and about mid-way between Kingston (Lacepede Bay) and Lake Alexandrina.

The bore was down 600 feet, and, after passing through various sandy, clayey, and calcareous layers, was going through a fine blue shale; the pieces brought up were too small, and showed no fossils, so that the geological age of the rock could not be judged; but I am inclined to think it may be cretaceous blue shale, such as Mr. Brown refers to at Mount Poole. Only salt water has, so far, been struck in this bore, though drinkable brackish water is obtained from shallow wells close by.

Referring again to the underground waters of the Wimmera district, it is clear that, were there no means of escape for them seaward, the newer formations resting on the impervious bed-rock, would in time have become so saturated, that the water would inevitably find exit at the surface by means of springs. There are here and there such springs in the Victorian portion of the Murray basin, but their united overflow would be but an insignificant fraction of the total amount of water moving towards the ocean.

Even the large springs referred to on the coast do not account for the escape of the water, the bulk of which, in all probability, comes out in springs beneath the sea.

There are two sets of conditions under which water may be found in the Wimmera district:—

1. Water obtained at shallow depths in the Post-Tertiary accumulations.

This has already been found in many places, and appears to result from local soakage; it varies in quality and quantity, according to the variations of the beds it occurs in, or has had to pass through, the amount of salt in those layers, their drainage areas, and other causes. In many cases, water found under these conditions has little or no subterranean means of escape; it accumulates by soakage from the surface into depressions in the layers, bringing with it whatever salt it takes up in its passage. In other instances, owing to the absence of salt in the layers, or to some means of escape, the water is merely brackish. In others again, the water has a movement in certain directions, and has carried away the salt from the beds it percolates, and consequently is fresh.

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* Mr. Henry Ford, foreman in charge of the water-boring operations near Bourke, has recently been eminently successful in obtaining copious and powerful supplies of artesian water, which in one case rose 20 feet above the surface, and has continued to flow without interruption ever since.

When the variable character and irregular distribution of the different layers constituting the Upper Tertiary beds are considered, it is easy to account for the differences in the waters of wells short distances apart, and the variable depths at which they are found.

Many of the fresh-water wells found under the above conditions may be most valuable to individual families, stations, and small centres of population, but it is scarcely to be expected that they will be found to furnish sufficiently copious supplies for large communities or for irrigation purposes, nor that their waters will be found to overflow at the surface.

Now that their existence is known, the search for fresh ones might be left to private enterprise.

2. Waters in or below either the Miocene or the cretaceous beds, percolating from the edges of the basin and determining towards the sea.

Such waters would almost certainly be fresh, owing to their having a regular motion, and having by degrees carried away the salt from the beds they permeate. They would be found flowing through underground caverns in the limestones or in loose gravelly beds below, and would probably be subject to pressures originating near the slopes of the Palæozoic rocks forming the margins of the basin; and though the means of escape seaward might be too easy to admit of their rising to the surface, they would certainly rise high above the level at which they were tapped in bores or shafts.

As an indication in favour of their rising to the surface may be mentioned the statement that, in driving, for the Stawell water supply, the tunnel through part of the Grampians, water was struck in the rock-layers passed through in sufficient quantity to materially augment the supply conveyed through the tunnel. Some of the Grampian beds (Upper Palæozoic) have an inclination towards the Wimmera district, and it is not improbable that, if intersected beneath the plains northward of Mount Arapiles, very strong pressure might be found to act on the percolating waters.

The discovery of wells under the above conditions would be of national importance, and the search for them would be as much a national undertaking as that for coal.

Briefly summarized, the conclusions which I beg to submit are as follows :—

1. That a very large aggregrate quantity of fresh water is in constant motion seaward beneath the Wimmera district, crossing a line, say, from Donald to the north-west corner of Victoria.

2. That the bulk of that water passes through, or under layers of Miocene, and perhaps, cretaceous, or even of Upper Palæozoic age.

3. That there is a strong probability of such waters being, under pressure, sufficient to cause them to rise to within a short distance of, if not above, the surface, and that, once found, the supply will be inexhaustible.

4. That every bore in search of such waters should be carried down persistently until either success is attained, or the Palæozoic schistose or granite bed-rock met with.

The last subjects to be considered are the lines on which bores should be put down, and the method of carrying out the operations.

With reference to the first, I would recommend that a line be chosen starting from Donald, or from some point between Donald and the north of Mount Arapiles, and extending in the direction of the Murray River, between the junction of the Darling and the north-west corner of the colony; that on such line bores be put down from 2 to 10 miles apart, the extent of the intervals being regulated according to the information obtained from each successive bore.

As to the boring operations themselves, I have in a previous report urged the necessity of most careful discrimination being used in selecting a person thoroughly experienced in all styles of boring machines to act as foreman in charge, and also of taking care that, whatever machine be used, every appliance be provided ready for immediate use in all emergencies.

I would further recommend that bores be commenced at the largest possible diameter, not less than 12 inches, and that tubing of graduated sizes be provided, so as to admit of "telescoping" the bores, when it is found that the larger sized tubes cannot be safely carried down further.

Finally, I would suggest that, where the soft upper layers have been pierced and tubed, and hard limestones or other rocks encountered, the diamond drill might be used with advantage to complete the boring. I am aware of the difficulty that would here arise from want of water for the drill, but this might be obviated by the use—for clearing out the cuttings—of the brackish water, which would, in many cases, be obtainable in sufficient quantity from a shallow well, sunk close at hand for the purpose.

In addition to the advantages which would accrue, from the discovery of a copious water supply, may be mentioned the valuable information which would be obtained, as to the geology and the possible concealed mineral resources of the country in which boring operations are here recommended. It is impossible to say what valuable deposits may or may not exist between the surface and the bed-rock beneath so vast an area of Post-Tertiary accumulations.

I have the honour to be, Sir,
Your obedient servant,
REGINALD A. F. MURRAY,
Geological Surveyor.

Thomas Couchman, Esq., C.E.,
Secretary for Mines and Water Supply, &c., Melbourne.

SECTION IV.

REPORTS RELATING TO DISCOVERIES OF MARBLE AND LIMESTONE.

PREFATORY REMARKS.

Owing to the rarity of anything approaching a workable marble in Victoria, great interest attaches to the information as to the Limestone River marbles, contributed by Mr. A. J. Agg, and to the remarks on the character of the rock by Professor McCoy and Mr. J. C. Newbery.

Mr. J. Stirling deserves great praise for the manner in which his contribution on the Bindi limestones treats of the geology of that imperfectly known portion of the colony.

PARTICULARS RESPECTING THE MARBLE DEPOSIT, LIMESTONE CREEK.

SIR, Elsternwick, 17th May, 1880.

I have the honour to thank you very much for the attention given to my son's letter of the 27th March, and especially for reserving the marble at the Murray River from free selection.

My son does not claim to be the discoverer of the marble. His letters, in your possession, show that he merely performed a promise, which implied prior knowledge on the part of the gentlemen he addressed, and who had been so kind as to offer beforehand to consider the quality and age of the marble.

But as you mention, in your letter of the 20th April, that the existence of the deposit was previously known to the officers of your department, I think it well to give you the following memoir, which will, I have no doubt, be confirmed in its respective parts by the gentlemen named, each of whom has had some share in the matter, and which will show how the knowledge, of which you speak, was derived.

Over twenty years ago, Mr. J. B. Humffray and myself were fellow-students at the University, and I mentioned to him the existence of limestone rock, of great geological age, as occurring at the Bindi station, in Upper Gippsland. In November, 1860, he became Minister of Mines, and one of his first acts was to bring Mr. Selwyn, then Director of the Geological Survey, to me at the Audit Office, when he asked me to repeat my statement. I did so, and Mr. Selwyn said that no such limestone was known in Australia. But he also said that the locality had never been visited, within his knowledge, by any geologist. A long conversation ended by Mr. Humffray furnishing Mr. Selwyn with authority to proceed to Bindi and investigate the subject. Mr. Selwyn did so, and, later on, was able to prove that the limestone was Devonian, the first ever found in Australia. From this circumstance the formation is called the Bindi limestone.

On the same occasion, before they left the room, the first geological sketch-map was decided on by Messrs. Humffray and Selwyn, because, as the former urged, there was no reason whatever why I, or others, had not long before communicated a knowledge of the limestone to Mr. Selwyn, except that there was no geological map; and everybody thought the department would of course know all about it.

You will observe that I claim no merit whatever in this matter. The information I gave to Mr. Humffray was the common property of old settlers in Gippsland. But it will be interesting to you to learn, that one of the first acts of the first Minister of Mines led to the cardinal discovery, by Mr. Selwyn, of the Bindi or Devonian limestone.

Mr. Selwyn's discovery has been largely extended since. The Buchan station, in particular, has long been known to have a much larger deposit of Devonian limestone than that at Bindi, and the Murray River rises, in its longest branch, as Mr. Brough Smyth's map of 1873 shows, in the Devonian. From the long-continued and splendid labours of Mr. Howitt, much of our knowledge on these and many other points is derived.

Wherever the Bindi limestone occurs, prospects of silver lead can be readily obtained, and one serious, though unprofitable, attempt was made by the Murrundal Silver Mining Company to work it. But of the modes of occurrence of metalliferous veins in the Devonian, miners know but little, being led astray, I fear, by analogy with the Silurian. If sufficient attention could be directed to the Devonian, there might, in the future, be a great development of silver lead mining.

However that may be, matters remained in the state mentioned until November, 1873, when I was crossing on public duty from Omeo to Bendoc. The old blazed line went round the head of the Murray, but I heard that two boys named Sheehan, nephews of Mr. Neil Pendergast, then of Mount Leinster proper, had gone out to tail cattle on the river. By following the cattle tracks I could save distance, and could also see the Devonian limestone, already, as I said, marked on Mr. Brough Smyth's map. I therefore ran the tracks (now become a beaten road), accompanied, as far as the river, by Mounted Constable Walsh, at present at Stratford. We found, on reaching the river, that the boys had built a hut, not on the mere limestone I had come to see, but on an extensive deposit of marble. The underwood was then thicker than now, but the marble was exposed in the valley everywhere within sight of the hut. This was on the 26th November, 1873, and I took specimens with me.

On the 1st December, 1873, I was on my downward journey, and at Gelantipy met Mr. Howitt going up; with him was Mr. Murray, the Geological Surveyor, making his first tour in East Gippsland. I described the locality, in the neighbourhood of which, though not at the spot itself, Mr. Howitt had often been. I also presented him with my specimens, and he promised to visit the place. On returning to town, I mentioned the whole matter to Mr. Brough Smyth at his office; with him there was, at the moment, Professor McCoy, who heard what passed.

I am aware that every step necessary for geological purposes was taken by Mr. Howitt, and the question whether the marble be really Devonian, or whether it be Silurian, has, for some years, been agitated. This was the reason why my son brought in February, this year, for examination by the learned Professor, specimens of all the rocks (running parallel with the marble) for 15 miles, from the Cobberas to the Benambras. So far, without fossils, this interesting question, as the Professor's letter, in your possession, shows, cannot be determined. My own expectation, from the mode of occurrence of the marble, was that it would prove to be Devonian, but a much more competent authority has a tendency the other way. Be the event as it may, the cause of my son's journey (under a belief on my part that the marble was Devonian) was a kind allusion made to me, in connexion with the Devonian, by the learned Professor in his great lecture on coal last year. The result of the journey has been eminently satisfactory, for the value of the marble, in a utilitarian point of view, has now been demonstrated, through the researches of the Professor, and of Mr. Newbery. The incredulity with which I had formerly to contend has now disappeared, and by your own prompt and timely intervention the marble has been reserved for public use.

Of the value of the marble, I may not have another opportunity of speaking, my intention being to leave the matter, as I always do, to the constituted authorities; and I am aware that you have already taken steps for procuring larger blocks than those brought by my son, and freer from surface infiltration. I will therefore conclude by mentioning that, though my son and myself have seen the marble only for a quarter of a mile, yet Mr. Howitt is known to have proved it for a length of 6 miles. Judging from the surface, therefore, a whole city might be built out of it, leaving ample for future generations. It is, so far as my reading proves, one of the largest deposits of fine marble in the world. For any indurated, amorphous limestone-rock, which will polish, is called marble; but fine marble, like that of Pentelicus, Carrara, or the Murray, which (as the learned Professor so thoughtfully pointed out) is crystalline, homogeneous, and free from organic remains, has at no time been plentiful. Old Rome was built of tufa; later Rome of brick; and the Augustine boast* proves the scarcity of marble. At Pompeii, an eminent architect of this city, not long ago, saw a column unearthed, which proved to be veneered with marble. I do not forget the monumental cities of Italy and other countries; but the marble is the accumulation of ages. Even in New York I am informed that it is used as a casing, like the freestone of our own elegant Town Hall. The extent of this deposit is, therefore, a principal factor in its value to the community.

In Melbourne, ever since I can recollect, a good freestone has been a desideratum. Large sums have been expended, and many researches made, but we are still dependent upon the fine quarries of the neighbouring colonies. Yet here, wholly within Victoria, in unlimited quantity, is the finest of all stone for building purposes, marked, as you remind us, in the records of the Mining Department, and known indeed for six years and a half to many persons, but to which no public attention has ever been directed.

I am, Sir,
Your most obedient servant,
ALFRED J. AGG.

Major Couchman,
Secretary for Mines, &c.

SPECIMEN No. 5142.

Office of Mines,
MEMORANDUM. Melbourne, March 31st, 1880.

I am acquainted with the marble referred in the attached correspondence, having seen it in 1874, and can fully endorse the opinions expressed as to its probable value, and the desirability of reserving from occupation the land on which it occurs; there is also a very beautiful, though small, stalactite cavern in the limestone, the area surrounding which should be reserved from alienation.

Though the examination made by me in 1874 was very brief, I am inclined to regard the rock as a Silurian limestone, metamorphosed near its contact with the neighbouring trappean rocks.

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* *Ut jure sit gloriatus, marmoream se relinquere, quam lateritiam, accepissit.*—SUETONIUS.

The difficulties of transit would be very considerable at present, but the future extension of railways will no doubt remove them to a great extent.

REGINALD A. F. MURRAY, Geologist.

Thomas Couchman, Esq., C.E.,
Secretary for Mines, &c., Melbourne.

SIR, Melbourne University, 27th March, 1880.

I do myself the honour to forward herewith copies of letters which have passed between Professor McCoy, J. Cosmo Newbery, Esq., and myself on the subject of a great deposit of marble which occurs at the Limestone River, the longest branch and true head of the River Murray, and wholly within this colony.

It will be seen that Professor McCoy has devoted time and great attention to a microscopic investigation, and that Mr. Newbery has kindly made a chemical analysis of the marble. The former speaks of it as a beautiful marble, and compares it with the famous white statuary and other allied marbles of Italy. The latter finds that it contains 96·8 per cent. of carbonate of lime.

I need hardly say that such a marble is almost indestructible by time, and that as, from surface indications, it appears to occur in vast quantity, its value as a building stone is very great. For the architectural monuments, if not for the ordinary houses of this city, it may be expected to be used.

Its geological age cannot, you will perceive, be at present determined, as it contains no organic remains, being rendered white and homogeneous by the heat of adjacent igneous rocks; but I may be allowed to hope, that some person, more fortunate than myself, may yet be able to collect and furnish to the learned Professor fossils from other parts of the valley.

In submitting the specimens to Professor McCoy and to Mr. Newbery, by both of whom I was encouraged to fetch them to Melbourne, I have done all that I originally intended; but I am advised that the marble is of great value, and that, as it belongs to the public, I ought to inform you, so that, if you think right, it may be reserved from selection under the Land Act, and may be dealt with under the regulations of the Mining Department.

Professor McCoy's specimens have been returned to him for his kind acceptance. Mr. Newbery's are lodged in the Technological Museum; but I forward herewith the best piece which remains.

The marble is distant 25 miles from Omeo Plains station, viz., to Mount Leinster station, 10 miles; to the dismantled homestead under Mount Leinster proper, 7 miles; and thence to the Limestone or Murray River, 8 miles. The road is now well defined, and is practicable, with care, for a bullock-dray; but a load would have to be brought up at places by instalments. There is a hut in a paddock at the end of the track, situated on the marble, so that it cannot be missed.

I have the honour to be, Sir,
Your most obedient servant,
ALFRED J. AGG, JUNR.

Major Couchman,
Secretary for Mines.

SIR, Charlton, Elsternwick, 24th February, 1880.

In accordance with the promise made to you on the night of your last lecture upon coal, I now beg to submit a specimen of the marble from the true head of the Murray River (called the Limestone River on the maps), about 7 miles from its highest source.

I have thought it well, at the same time, to supply you with specimens of the rock, as per list enclosed, from the summits of the ranges and the beds of the rivers, in a section of about 15 miles from the Cobbera to the Benambra mountains.

The marble exists in great quantity. Of course much of it is covered by earth, but it crops out for a full quarter of a mile down the river, and nearly as much on the slope. It is probably much greater, especially in length, down the river; but the time at my disposal prevented further search, and I have only to add that the specimens are such as I could break off from the surface with the appliances at the moment available.

I have, &c.,

ALFRED J. AGG, JUNR.

To Professor McCoy,
Director National Museum.

List Referred to above.

List of specimens of rocks collected in a section of fifteen miles across the true head of the Murray River from the Cobbera to the Benambra mountains :—

1. From a spur of the Cobberas at an altitude of probably 5,000 feet.
2. Portion of rock projecting above the Buchan River (Native Dog Creek).
3. Loose piece from the bed of the same river.
4. From the summit of the Dividing Range between the Buchan and the Murray rivers (Limestone River).
5. Piece of marble broken from the rocks projecting above the Murray River.
6. From the summit of the Dividing Range between the Murray River and Lake Omeo.

ALFRED J. AGG, JUNR.

24/2/80.

MY DEAR SIR, University, 24th March, 1880.

I have examined your six specimens, returned herewith, after some delay caused by the pressure of the University examination.

I greatly regret that I cannot determine the age of the beautiful marble, No. 5, from the Limestone or Murray River, as there is no trace of a fossil to be seen, even although I had fragments ground for microscopic search for minute organisms. Like the famous white statuary and other allied marbles of Italy, it is a metamorphic limestone, rendered white and homogeneous by the heat of some adjacent igneous rocks, which doubtless at the same time destroyed the traces of fossils.

The other five specimens are not marble or limestone, but siliceous and felspathic trap rocks of igneous origin.

FREDERICK McCOY.

To A. Agg, Junr., Esq.

SIR, Charlton, Elsternwick, 24th February, 1880.

In accordance with the promise made to you on the last night of Professor McCoy's great lecture upon coal, I now beg to submit a specimen of the marble from the Murray River (called the Limestone River on the map) about 7 miles from its highest source. I have furnished a similar specimen to Professor McCoy, with portions of rocks from the summits of the ranges and beds of the rivers, in a section of about 15 miles from the Cobbera to the Benambra mountains.

The marble exists in great quantity, and I have observed the outcrop for a full quarter of a mile down the river, and nearly as much on the slope. It is probably much greater, especially in length, down the river, but the time at my disposal prevented further search. As the specimen shows, it is only such as I could break off from the surface.

ALFRED J. AGG, JUNR.

J. Cosmo Newbery, Esq.,
Scientific Superintendent Industrial and Technological Museum.

Public Library, Museums, and National Gallery of Victoria,
Melbourne, 5th March, 1880.

Dear Sir,

Many thanks for the specimens of marble you sent to me from the Limestone River. I have placed them in the Museum collection.

On analysis it gives out in 100 parts :—

Carbonate of lime	96·80
Carbonate of magnesia	2·80
Soluble silica	0·20
Insoluble silica	0·10
Water	0·10
	100·00

I have excluded oxide of iron from the analysis, as it seems to be due to surface infiltrations in crack and joint lines.

When railways open up the district, we may draw part of our marble supplies from it, as the texture seems to be good.

J. COSMO NEWBERY.

To Alfred J. Agg, Junr., Esq., Elsternwick.

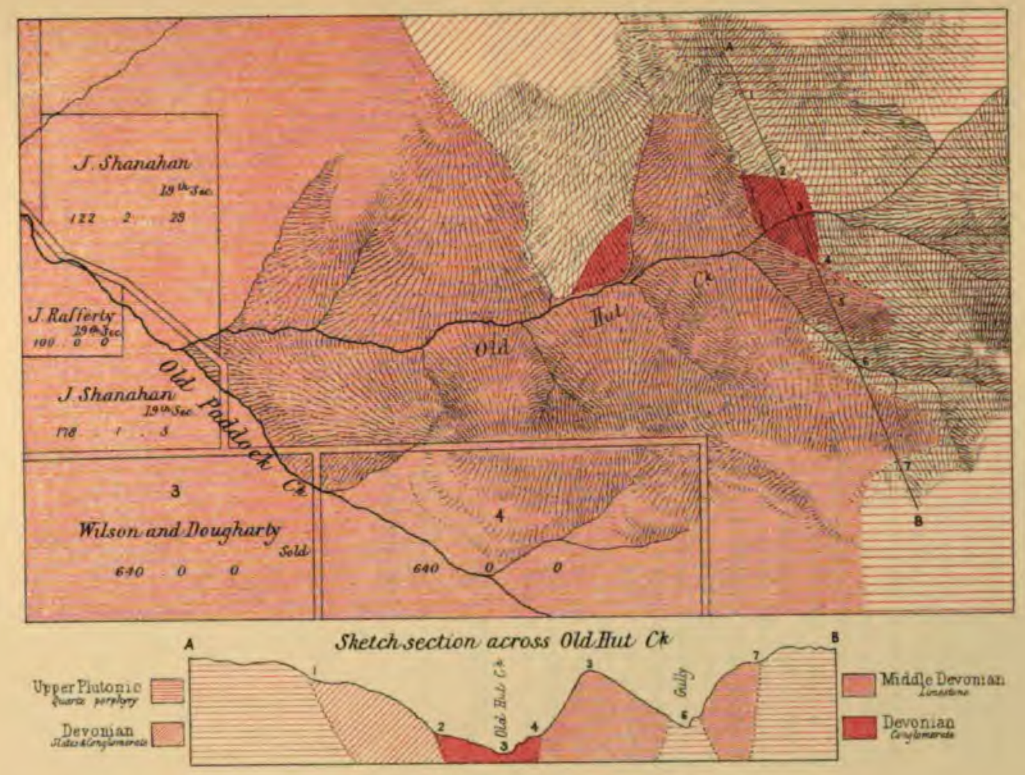
NOTES ON THE MARBLE BEDS AT BINDI.

(By the Land Officer at Omeo.)

Old-Hut Creek, or the left-hand branch of an eastern affluent of the Tambo River, called Old Paddock Creek, which intersects the Middle Devonian marine limestones of Bindi, has laid bare by erosion some interesting geological features, which are roughly delineated on attached diagrams. At a point on Old-Hut Creek, about 1½ miles from the eastern boundary of James Shanahan's 19th section allotment, the Bindi limestones are seen to be bounded by massive quartz porphyries, which have indurated, and otherwise altered the limestone sediments at contact, into whitish crystalline and sub-crystalline marbles. At lower levels, protruding from the alluvium in the bed of the creek, and for a short distance up the hill sides, are masses of reddish or purplish conglomerates, apparently identical in lithological character with the Mount Tambo beds. As the latter at this place would appear to occupy a position inferior to the Bindi limestones, while elsewhere they have been shown to be superior, that is, of later origin (Upper Devonian), it becomes interesting to note how far a cross-section at this point tends to throw light upon the actual stratigraphical position of the Bindi limestones and the Mount Tambo conglomerates. The porphyritic rock masses are clearly intrusive, as evidenced by the alteration of the sedimentary rocks in contact, and may be provisionally named upper plutonic, in contradistinction to the granitic or lower plutonic masses occurring elsewhere in the neighbourhood. These porphyries would further appear to be made up of constituents similar to (and are probably of the same age as) intrusive masses which have burst through the metamorphic schists near Omeo. The question is not, however, as to the age or lithological character of the intrusive porphyries, but rather the age of the conglomerates with reference to the Bindi limestones. Following the sectional line from A to B (*vide* Plan), we find the crest of the ridge forming the northern watershed line of Old-Hut Creek made up of massive porphyries of brownish colour and harsh texture ; in descending the hillside towards the creek, are seen finely laminated, soft, yellow and brownish slates, presenting near the porphyries a silky wrinkled appearance, as if partially metamorphised into mica schist. At lower levels, the sediments become more siliceous, having an almost vertical dip. Near the bed of the creek are protruding blocks of purplish and brownish conglomerate, the dip being rather obscure, and the rocks in some places showing traces of silicification ; the bed of the creek is made up of large and small waterworn boulders and

SKETCH PLAN

To shew Geology of portion of Old Hut Cᵏ BINDI



Scale 40 chains to 1 inch

alluvium. On ascending the hillside, which is very steep, the conglomerates again appear, giving place at higher levels to the normal blue limestones of the locality; these beds vary in thickness from 3 inches to as many feet, and show a dip of 60° S.W.; they are continuous over the ridge, but at the bed of a small gully (see No. 6 on section) the porphyries again appear, and the limestones at contact, and for a distance of 10 or 12 feet, are marbleiferous, and white to grey in colour. Ascending the steep hillside, the limestones are continuous to the crest of the ridge dividing the Old-Hut Creek from its recipient, Old Paddock Creek; here the porphyries again appear as shown on sketch.

From the foregoing sectional notes, it would appear that the slates and conglomerates are stratigaphically inferior to the limestone beds, and if the former are indeed the analogues of the Mount Tambo series (slates and conglomerates), then there are reasons for assigning to them a greater antiquity than the Bindi limestones; or, in other words, admitting the presence of such characteristic fossils as spirifera lævicosta,* &c., to indicate the age of the Bindi limestones as Middle Devonian, then the slates, sandstones, and purple conglomerates of Mount Tambo would appear to be of Lower Devonian age. This would coincide with the views of Mr. Selwyn, the late Director of the Geological Survey of Victoria.† Yet it must be borne in mind that Mr. Howitt, in his interesting article on the Devonian rocks of North Gippsland,‡ from observations made near the Mount Tambo beds, came to an opposite conclusion, referring the latter to the Upper Devonian age, and consequently making them superior to the Bindi limestones. A detailed examination of the Bindi limestones and their bounding rocks is required to settle this important question. So far as the marble deposits are concerned, it does not seem probable that any commercially valuable quarries would be opened in the locality, from the fact that the limestones are only altered for a short distance from the contact with the intrusive porphyries, and even where the crystallization of the rock masses are greatest the rock is full of thin yellow seams parallel to the bedding planes, which would probably deteriorate from its commercial value.

JAMES STIRLING.

21/3/83.

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* Prodromus Palæontology of Victoria, Decade IV., page 16.

† Essay on Physical Geography and Geology of Victoria, p. 159. (Exhibition Essay.)

‡ Progress Report, Geological Survey of Victoria, p. 231.

DONORS TO DEPARTMENTAL COLLECTION AT EXHIBITIONS.

Special thanks are again tendered to the following mining companies, mine owners, and other gentlemen, who, where practicable, when called upon, rendered willing assistance in procuring specimens of rocks, minerals, fossils, &c., necessary to complete the Departmental Geological and Mineralogical collection so successfully exhibited at the Sydney, Melbourne, and Amsterdam Exhibitions :—

The Mining Surveyors and Registrars.

The Foreman in charge of Diamond Drills.

The following Quartz Mining Companies:—

Name of Company.	Locality of Mine.
Magdala	Stawell
Extended Cross Reef	Stawell
Old Hampshire	Stawell
Pleasant Creek Cross Reef	Stawell
New Scotchmans	Stawell
The Oriental	Stawell
The Ararat	Ararat
Jersey Reef	Inglewood
Queen's Reef	Moliagul
Queen's Birthday	Dunolly
North Birthday	Goldsborough
Sydenham	Dunolly
Burke's Flat Tribute	near Dunolly
Telegraph Extended	Maryborough
Union	Amherst
New Briseis	Amherst
Perseverance United	Talbot
Port Phillip	Talbot
New North Clunes	Clunes
South Clunes	Clunes
Band and Albion Consols	Ballarat
Hopewell Tribute	Staffordshire Reef
Willams' Fancy	Staffordshire Reef
New Kangaroo	Staffordshire Reef
Little Hopewell	Staffordshire Reef
New Venture	Staffordshire Reef
Imperial	Buninyong
One-and-All	Buninyong
Parker's United	Gordon
Golden Point	Blackwood
Victoria	Blackwood
Ida	Blackwood
Koh-i-noor	Blackwood
Cornish	Blackwood
North Britain	Blackwood
North Star	Blackwood
Sultan	Blackwood
Duke of Cornwall	Fryerstown
Koch's Pioneer	Sandhurst
Alison	Costerfield
Good Luck	Rushworth
Horsford's Mine	Anderson's Creek
Progress	Panton Hill
Pigtail	Warrandyte
Crown	Warrandyte
Oram's Reef	Kingstown
The Central	Reefton
Just-in-Time	Gobur
Robinson's Reef	Gobur
Long Tunnel	Walhalla

DONORS—*continued.*

Name of Company.	Locality of Mine.
Walhalla	Walhalla
Hit-or-Miss	Donnelly's Creek
Normanby	Dargo
Egerton	Egerton
Washington Freehold	Ballarat
Harp of Erin Company	Freeburgh
Good Hope Company	Grant
Triumph Company	Grant
Jewellers' Shop Mine	Grant

The following Alluvial Mining Companies:—

Name of Company.	Locality of Mine.
A1 Deep Lead	Stawell
New Victoria	near Beaufort
Working Miners	Homebush Lead, near Avoca
Duke	Timor, near Maryborough
Argus	Chinaman's Flat, near Maryborough
Seham	Alma Lead, near Maryborough
Gladstone	Alma Lead, near Maryborough
Count Bismarck	Alma Lead, near Maryborough
Woolbrook	near Carisbrook
Union	Mount Greenock
Dyke's Freehold	Spring Hill, near Creswick
Ristori	Spring Hill, near Creswick
Reform	Haddon
Lucky	near Staffordshire Reef
Band of Hope and Albion Consols	Ballarat
Prince Extended	Daylesford
Warrandyte	Warrandyte
Victoria Hydraulic Slucing	Warburton
Blue Rock	Tanjil
Chiltern Valley	Chiltern
United Eldorado Gold and Tin	Eldorado

The following Owners of Quartz Mines, Claims, &c.:—

Name of Mine Owner.	Locality of Mine.
Messrs. Forster and Smith	Moyston
Patrick Toomey	Moonambel
Messrs. Goddard and Balmer	Moonambel
Messrs. Flinn and Pollard	Moliagul
Messrs. Anderson Brothers	Maryborough
Messrs. Wilson and Dark	near Maryborough
Messrs. Gray and party	near Maryborough
Messrs. Wangemann and party	near Maryborough
Messrs. Hamilton and party	near Maryborough
Messrs. Bartels and Company	Newton
Messrs. Dolcouth and Company	Buninyong
Messrs. Webb Brothers	Buninyong
A. Mills	Fryerstown
Messrs. Rowe Brothers	Fryerstown
Messrs. Sinnet and Company	Rushworth
Messrs. Rich and Randolph	Rushworth

DONORS—*continued.*

Name of Mine Owner.	Locality of Mine.
Messrs. Clausen and Son	Rushworth
Messrs. Grumbridge and Mackie	Coy's Diggings
Mr. Horsford	Anderson's Creek
Messrs. Ewart and party	Muddy Creek, Upper Yarra
Mr. R. G. Meade	Strathbogie Ranges
Mr. J. P. Sherring	Strathbogie Ranges
Mr. C. F. McDougall	Dry Creek, near Jericho
Mr. Wm. Hooley	Rutherglen
Messrs. Harris and Hollow	Rutherglen
Messrs. Thomas Brown and Company	Rutherglen
Messrs. E. Lord and Company	Rutherglen
Messrs. E. G. Miller and Company	Chiltern
Messrs. E. Barrass and Company	Chiltern
Messrs. Myers and Company	Coy's Diggings
Messrs. Taylor and Murray	Coy's Diggings
Messrs. Buchanan and Company	Chiltern
Messrs. Lambert and O'Brien	Chiltern
Mr. R. Arrowsmith	Chiltern
Messrs. Hacked and Company	Yackandandah
Mr. Green	Yackandandah
Messrs. E. Shelly and Company	Yackandandah
Messrs. D. McLeod and Company	Mitta Mitta Junction
Mr. C. Fraser	Morse's Creek
Mr. C. McGill	Wandiligong
Messrs. Hood and Coutts	Growler's Creek
Mr. T. Symes	Growler's Creek
Mr. A. Attridge	Growler's Creek
Mr. J. McDiarmid	Nicholson River, Gippsland

The following Owners of Alluvial Mines, Claims, &c. :—

Name of Mine Owner.	Locality of Mine.
Messrs. Edwards and Co.	Inglewood
Mr. R. R. Crawford	Londonderry, near Ararat
Mr. W. Samering	Port Curtis, near Ararat
Messrs. Grant and party	Break-o'-Day, near Rokewood
Messrs. Turner and party	near Staffordshire Reef
Messrs. Mankey and Company	near Buninyong
Messrs. Cosswell and Company	near Buninyong
Messrs. Croker Brothers	Blackwood
Mr. J. K. Elliot	Blackwood
Mr. W. Wernham	Tarilta
Mr. W. Tonkin	Fryerstown
Messrs. Parsons, Tonkin, and Company	near Fryerstown
Mr. John Batey	Fryerstown
Mr. S. Roberts	Vaughan
Messrs. Ewart, Lithgow, and Hampden	Hoddle's Creek
Messrs. Munro and Croom	near Warburton
Messrs. A. Lamond and party	Tanjil
Ah Cow and party	Jordan River, Jericho
Messrs. May and Company	Woolshed, near Beechworth
Messrs. Hillyer and Company	Cotton-tree Creek
Mr. August Lawers	Fell-timber Creek
Mrs. Shugg and Company	Yackandandah
Messrs. Jessup and Company	Yackandandah
Messrs. Hall and Company	near Sarsfield
Messrs. Gribble and Company	Morse's Creek
Mr. J. McDiarmid	Nicholson River, Gippsland
Mr. W. Radcliffe	Buckland

DONORS—*continued.*

To the following Companies for Minerals, Metals, and other Miscellaneous Specimens :—

Name of Company.	Locality from whence Specimens were obtained.	Particulars of Specimens.
Sydenham	Dunolly	Pyrites (auriferous)
Bristol Hill	Maryborough	Pyrites (auriferous)
Sultan	Barry's Reef	Quartz tailings and pyrites
Long Tunnel	Walhalla	Raw and calcined pyrites
United Eldorado	near Beechworth	Stream tin
Walhalla Copper Mining	near Walhalla	Ores of copper, regulus, &c.
The Black Cloud Gold and Antimony	Whroo	Sulphide of antimony
The Alison	Costerfield	Sulphide of antimony
Antimony Works	Melbourne	Star antimony
Queen's Birthday Quartz Crushing Company	Dunolly	Gold in quartz
D. McGeorge	Muddy Creek, near Hamilton	Oligocene fossils
Edwin Gill	Laen	Samples of borings from marine beds of Miocene age underlying Tertiary plains

To the following gentlemen for contributions of Minerals, Metals, and other Miscellaneous Specimens :—

Name of Contributer.	Locality from whence Specimens were obtained.	Particulars of Specimens.
A. M. Smith	Sandhurst	General collection
H. B. Nicholas	Castlemaine & Maryborough	General collection
C. Stewart	Ballarat	General collection
R. H. Bland	Clunes	General collection
M. Ord	Stawell	General collection
A. Alderdice	Beechworth	General collection
R. Arrowsmith	Chiltern and Rutherglen	General collection
R. Hall	Daylesford	General collection
The Hon. J. A. Wallace	Bethanga	Ores of copper, &c.
Messrs. Harris and Hollow	Bethanga	Ores of copper, &c.
Messrs. Kitchingham	Bethanga	Ores of copper, &c.
Messrs. Rhodes and Co.	Bethanga	Ores of copper, &c.
H. Rosales	Walhalla	Ores of copper, &c.
J. Munday	Walhalla	Ores of copper, &c.
A. R. Wallis	Dookie	Calcite and ironstone
Norman Taylor	Kilcunda	Rock sandstone, &c.
E. M. Cairnes	Blackwood and Richmond	Gem sand and zeolites
D. Fletcher	Beechworth	Agates and sluice model
C. Le Cren	Gippsland	Encrinital limestone
A. Hunter	Gippsland	Encrinital limestone
J. Rowan	Blackwood	Antimony ore
R. A. F. Murray	Melbourne	Various specimens
J. C. Newbery	Melbourne	Various specimens
H. O. Rule	Melbourne	Various specimens
R. D. Duncan	Melbourne	Various specimens
Messrs. Sherring	Dry Creek	Pebbles and brach
W. Güttman	Donnelly's Creek	Gold in quartz
H. Luke	Sale	Various specimens
M. R. Fraser	Eureka Reef, Castlemaine	Translucent quartz, &c.
Messrs. Lock	Tarrangower	Gold in quartz
J. Andrews	Richmond	Zeolites, &c.
H. H. Gibson	Glenample	Cliff specimens, fossil clay, &c.
W. McKean	Geelong	Greenstone, &c.
W. Scott	Buchan	Galena
H. Brown	Heathcote	Antimony ore
J. Meldrum	Longford	Limestone
W. Millar	Wilson's Promontory	Tourmaline
M. J. Brache	near Walhalla	Cobaltiferous manganese ore

DONORS—*continued.*

To the following, for Specimens, &c., donated to the Mining Department, or obtained, by way of exchange, at the closing of the Melbourne International Exhibition:—

From whom obtained.	Number and Description of Specimens, &c.	
	Auriferous Quartz.	
Bristol Hill Mine, Maryborough (Anderson Bros.)	Five Specimens of Quartz, richly impregnated with Gold, from a depth of 600 feet—width of reef, 15 inches	
Telegraph Extended Quartz Mining Company	Five Specimens of Quartz, showing Gold Pyrites and Galena, from a depth of 380 feet	
Union Gold Mining Company, Amherst	Three Specimens of Quartz, showing Gold Pyrites and Zinc blende, from 250 feet deep	
All Nations Reef	Two Specimens of Quartz, showing Gold freely, from a depth of 150 feet	
Eureka Reef, Castlemaine, Mr. R. Fraser	Two Specimens—one a "Sclickenside," a very fine Specimen, showing much Gold; and one of translucent Quartz, with Gold and Galena	
Messrs. Lock, Tarrangower	One Specimen of Auriferous Quartz, Gold plainly visible	
Parkins' Reef Tribute Company, Tarrangower	Four Specimens of Quartz—three of which have been roasted—showing Gold freed from the Pyrites by Roasting, and one of raw Quartz showing much Gold on one face	
Rowe Brothers, Fryerstown	One Specimen of White Quartz, with Slate and Gold	
,,	A number of Quartz Crystals of irregular form	
E. W. H. Rowe, Castlemaine	One very rich Specimen of Auriferous Quartz, with some Zinc-blende	
New Era Company, Fryerstown	One Specimen of Auriferous Quartz, Gold visible	
Royal Saxon Company ...	Two Specimens of Quartz, showing Gold freely	
	Auriferous Washdirt and Cement.	
Union Gold Mining Tribute Company, Mt. Greenock	One polished Cedar and Glass Case, containing Washdirt and showing Gold	
Working Miners' Company, Homebush	One polished Cedar and Glass Case containing, in separate divisions, Washdirt, showing Gold and Reef from north and South portions of the mine; also, fac-simile of Nugget found in the wash shown	
T. Bartlemore, Back Creek	Three Specimens of Auriferous Cement, all which show coarse Gold	
J. M. Barr, M.P.	A number of Specimens of Auriferous Cement from Majorca	
	Miscellaneous Minerals, &c.	
	One Sample of Tin Ore, Koeting	
	One Stalactite of Smelted Tin, furnace drippings, Tallangatta	
D. Fletcher	One piece of Agate (polished)	
Harris and Hollow, Bethanga	Two large blocks of Copper Ore, from the "Pride of Bethanga" mine, Bethanga. Assay, 45 per cent. Copper, 1oz. 3dwt. Gold, 2oz. 0dwt. 8grs. of Silver, per ton	
J. Blight, Mount Alexander Quarry	Specimen of Granite, showing on one face a patch of Molybdenite, and some Copper Pyrites	
Rowe Brothers, Fryerstown	A number of Specimens of Iron Pyrites crystallized on Slate, Fryerstown	
,,	Secondary Pyrites containing Gold	
J. Brache	Two large blocks of Cobalt Ore, from Walhalla	
	One large piece of Cobalt Ore, from Molesworth	
R. G. Ford	One Specimen showing "dendritic" markings of Manganese on Grampians Sandstone	
	One large block of Iron Ore from Lal Lal	
Sandhurst School of Mines, through Wm. Nicholas	One Sample Roasted Pyrites	All from Sandhurst Pyrites Works
,,	One Sample Pyrites Tailings	
,,	One Sample Pyrites Slimes	
,,	One Sample from Chimney	
J. M. Barr, M.P.	A number of Magnesian Concretions of a variety of forms, from Majorca	

DONORS—*continued.*

From whom obtained.	Number and Description of Specimen, &c.	
J. M. Barr, M.P.	Two large pieces of Lignite, Lal Lal	
"	Two large pieces of Lignite, McKirley's Creek	
"	Two large pieces of Lignite Coal, Kilcunda	
A. D. Hunter	One Slab of Encrinital Marble (polished), from the Thomson River, Queensland	
"	One piece of Limestone, from Lillydale	
J. Blight	Four Cubes of Granite, one face of each of which is polished, from the Mount Alexander quarry	
H. B. Nicholas	One piece of Light grey Granite, Majorca	
Castlemaine Paving Company	Three large Slabs of Slate (sawn) and two pieces moulded for brackets	
Telegraph Extended Company, Maryborough ...	Two pieces of Rock from hanging and foot walls respectively, Telegraph Extended Company, Maryborough	
H. B. Nicholas	Two pieces of Metamorphosed Sandstone, from Deed's Reef, Majorca	
"	One piece of Metamorphosed Sandstone, from the Castlemaine Town Quarry	
Royal Saxon Company, Golden Gully, Fryerstown	Two Specimens enclosing Rock from the hanging and footwalls of reef	
Rowe Brothers	One Nodule of Sandstone, Rowe Brothers' mine, Fryerstown	
D. White, Stawell	One Cedar and Glass Case of Cores, obtained by means of boring with the underground diamond-drill in the shaft of the Great Northern Company, Stawell	
D. Fletcher, Beechworth ...	Model of Sluice, used in the Beechworth district for alluvial washing on a large scale, showing the different kinds of "false" bottoms used.	
	South Australia.	
Through T. C. Cloud, manager of the Wallaroo Smelting Works, Wallaroo, S.A.	Two Specimens of Bornite, Moonta mine	
"	One Specimen of Chalcopyrite and Bornite, Moonta mine	
"	Two Specimens of Peacock Ore, Moonta mine	
"	Two Specimens of Chalcopyrite, Moonta mine	
"	Two Specimens of Massive Atacamite, Moonta mine	
"	One Specimen of Chalcopyrite, Kurilla mine	
"	Two Specimens Chalcopyrite, Wallaroo mine	
South Australian Commissioners	One Specimen of Iron Ore, Northern Territory	
"	One Specimen of Micaceous Iron Gre, Angaston	
"	One Specimen of Limestone, Mount Torrens.	
	Tasmania.	
The Secretary to the Tasmanian Commissioners	One Sample Fine Tin, fine jigger	All from Mount Bischoff mine
"	One Sample Coarse Tin, coarse jigger, first sieve	
"	One Sample Rough Ore, from coarse jigger, crushing product	
"	One Sample Produce of first sieve, from self-acting jiggers	
"	One Sample Produce of first sieve, from self-acting jigger	
"	One "Nugget" of Solid Tin Ore, broken from a lump 43lbs. weight	
"	One Specimen Rich Lode Tin, from "brown" face	
"	One Specimen Red Porphyry	
"	Seven Specimens of Lode Tin from Mount Bischoff and its vicinity, full particulars of which could not be obtained	
"	Two Specimens of Tasmanite (a new mineral), Mersey River	
"	One Specimen of Iron Ore, River Tamar.	
"	One block of Coal, Jerusalem	
"	Two blocks of Shell Limestone, Bridgewater.	

DONORS—*continued.*

From whom obtained.	Number and Description of Specimens, &c.
	West Australia.
West Australian Commissioners	One Specimen of Galena, from near surface "The Sisters" mine, South Geraldine
"	Two Specimens of Carbonate of Lead, South Geraldine mine
"	One Specimen of Galena, Wheal Ellen mine
"	One Specimen of Nodular Iron Pyrites with enclosed patches of Galena, Wheal Ellen mine
"	One Specimen of Zinc-blende, Wheal Ellen mine
"	One Specimen of Copper Ore, Wheal Alpha mine, Northampton
"	Two Specimens of Copper Ore, South Geraldine.
	New Zealand.
Dr. Hector, F.G.S. ...	One Specimen of Chrome Ore, Nelson
"	One Specimen Zinc-blende, Nelson
"	One Sample Iron Sand, Taranaki
	Straits Settlements.
Acting-Commissioner for the Straits Settlements	One Sample of Stream Tin Ore, Perak
"	One Sample of Stream Tin Ore, Perak
"	One Sample of Stream Tin Ore, Kinta R.
"	One Sample of Stream Tin Ore, Kongsee
"	One Sample of Stream Tin Ore, Kongsee
"	One Sample of Stream Tin Ore, Penang
"	One Sample of Stream Tin Ore, Salangor
"	One Sample of Stream Tin Ore, Malacca
"	One Sample of Stream Tin Ore, Malay Peninsula

LIST OF MAPS AND PLANS

OBTAINED AT THE MELBOURNE INTERNATIONAL EXHIBITION 1880–81 FOR THE MINING DEPARTMENT.

South Australia.

1. Plan showing Natural Features of the Country, Towns, Roads, &c., at and in the vicinity of Port Darwin.
2. Plan showing the Adelaide and Port Darwin Telegraph Line.
3. Plan of Explorations. By J. Ross. 1874.
4. Map showing Route Traversed by Exploration Party commanded by J. W. Lewis. 1874-5.
5. Map showing the Route Traversed and Discoveries made by Ernest Giles, between the years 1872 and 1876.
6. Map of Route Traversed and Discoveries made by W. C. Gosse, 1876.
7. Map showing Explorations between Alice Springs and the Eastern Boundary of the Province. By Hy. Barclay, A.I.C.E., F.R.A.S. 1878.
8. Map showing Explorations N.E. of Alice Springs. By C. Winnicke. 1878.
9. Plan showing Approximate Positions of Pastoral Claims and Northern Territory.
10. Plan of the Southern Portion of the Province of South Australia, as divided into Counties and Hundreds, showing Post Towns, Telegraph Stations, Main Roads, Railways, &c. 1880.

1894.

VICTORIA.

New South Wales.

1. Eight Diagrams of Coal Sections. Presented by John Mackenzie, Esq., F.G.S., Government Examiner of Coal Fields.
2. Geological Sketch Map of New South Wales.

West Australia.

1. Plan of the Town of Freemantle. 1880.
2. Map of the Kimberly District. 1881.
3. Map of Perth District. 1879.
4. Plan of Exmouth Gulf District.
5. Map of Portion of the Colony of West Australia, showing Timber Forests (colored).

LIST OF PUBLICATIONS

OBTAINED AT THE MELBOURNE INTERNATIONAL EXHIBITION 1880–81 FOR THE MINING DEPARTMENT.

West Australia.

1. Hand-book of West Australia, with Photo. Illustrations. By the Rev. C. G. Nicolay. 1880.
2. The Forest Resources of West Australia. By Baron F. von Müeller (with Illustrations).
3. Journal of Expedition from De Grey River to Port Darwin. By A. Forrest, F.R.G.S., with numerous Illustrations, and Map showing the Route Traversed by Mr. Forrest's Party. 1880.
4. Blue Book, 1880.
5. Census, 1870.

South Australia.

1. Hand-book of South Australia, Historical and Statistical, with Diagrams and Map. 1880.

New South Wales.

1. Catalogue (with Preliminary Remarks) of Exhibits.

Queensland.

1. Catalogue of Exhibits, with Essay descriptive of the Colony.

Tasmania.

1. Catalogue of Exhibits, with a General Description of the Colony; and Map, on which are shown, in colours, the localities where Gold, Tin, and Coal are found.

New Zealand.

1. Handbook with Maps, Plates, and Diagrams.
2. Catalogue of Exhibits.

United States.

1. Catalogue of Exhibits, with Statistical Sketch.

DONATIONS TO THE LIBRARY OF THE DEPARTMENT OF MINES FROM 1st JULY, 1879, TO 31st DECEMBER, 1883.

America.

Canada.

Geological Survey of Canada, 1879–80.
Maps of the Geological Survey of Canada, 1879–80.

United States.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. iv., Nos. 2, 3, 4; Vol. v., Nos. 1, 2, 3, 4; Vol. vi., Nos. 1 and 2.
United States Geological Survey:—
    Reports for 1876 and 1877.
    Illustrations of Cretaceous and Tertiary Plants.
    Fresh-water Rhizopods.
    Birds of the Colorado Valley.
    Natural History of the North American Pinnipeds.
    Ethnology and Philology of the Hidatsa Indians.
    Bibliography of the North American Invertebrate Palæontology.
    Catalogue of Publications, 2nd edition.
    Catalogue of Publications, 3rd edition.
    First Annual Report of the United States Geological Survey, 1880.
Report of the Comptroller of the Currency, 1880.
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Geological Survey of Indiana, 1880; do., 1881.
American Museum of Natural History, Bulletin No. 1.
Boston Society of Natural History:—
    Memoirs of. Vol. ii., Part 4, No. vi.; Vol. iii., Part 1, Nos. i., ii, iii., iv., and v.
    Proceeding of. Vol. xix., Parts 1, 2, 3, 4; Vol. xx., Parts, 1, 2, 3, 4; Vol. xxi., Parts 1, 2, and 3.
    Occasional Papers of. No. iii.
    Anniversary Memoirs of. 1830 to 1880.
Smithsonian Institute:—
    Reports for 1877, 1878, 1879, and 1880.
    List of Foreign Correspondents.
St. Louis Public School Library Report, 1878.
Sixty-first Annual Report of the Board of Public Education, Philadelphia, 1880.
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"Science." Vol. i., Nos. 1 and 14.

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Great Britain.

Transactions of the Edinburgh Geological Society. Vol. iii., Part 2; Vol. iv., Parts 1 and 2.
Transactions of the Royal Geological Society of Cornwall. Vol. x., Parts 1 and 2.
Proceedings of the Royal Geographical Society. Vol. xx., Nos. 4, 5, 6; Vol. xxi., Nos. 4 and 5; Vol. xxii., No. 6; New Series, Vol. i., No. 11.
North of England Institute of Mining and Mechanical Engineers:—
    Transactions, Vol. xxviii, 1878–9; Vol. xxix., 1879–80.
    Illustrations of Fossil Plants.
    Borings and Sinkings, C.—E.
Colonial Office List, 1880, 1882, 1883.
Reports of the Inspectors of Mines to H. M. Secretary of State, 1879, 1880, 1881, 1882.

1894.
VICTORIA.

Fourth Annual Report of H. M. Inspectors of Explosives, 1879.
Gold; its Occurrence and Extraction. (A. G. Lock.)
"The Ironmonger," 3rd March 1883.
Minutes of Proceedings of the Institution of Civil Engineers. Vols. 68, 69, 70, and 71.
Attwood on the Chile Vein Gold Works.
Miners' Association of Cornwall and Devon, Reports, &c., 1882.

France.

Descriptive Notices on the Designs, Models, and Works exhibited at Melbourne, 1880–81.
Compte Rendu des Séances de la Commission Internationale de Nomenclature Géologique. Foix, 1882.

Belgium.

Publications de l'Institut Royal Grand-Ducal de Luxembourg, 1879.
Extrait du Bulletin du Musée Royal d'Histoire Naturelle de Belgique. Tome I. 1882.

Netherlands.

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Jaarbock van het Mijnroezen in Nederlandsch Oost Indie, 1879 to 1882 incl.

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  Philosophisch-historische Abtheilung, 1871, 1872–3.
  Abtheilung für Naturwissenschaften und Medicin, 1869–72, 1872–3.
  Fest-Grusz der Schles. Gesellschaft für Vaterländisch Cultur, 1874.
  Fortsetzung des Verzeichnisses, &c., &c., 1804–76.
  General Sachregister, &c., &c., 1804–76.
  Jahres-Bericht, 1870 to 1879, 1881.
Sitzungs-Berichte der Naturwissenschaftlichen Gesellschaft Isis in Dresden. Vols. I. and II., 1879; Vols. I. and II., 1880; Vol. II., 1881; Vols. I. and II., 1882; Vol. I., 1883.
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Mittheilungen des Vereins für Erdkunde zu Halle. 1879, 1881, 1882.
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Geographer Monats-Bericht.
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Die Königsleiche Deutsche Akademie der Naturforscher:—
  Die Tertiärflora von Göhren. (Engelhardt.)
  Ueber ein Aequivalent der takonischen Schiefer Nordamerikas in Deutschland. (Geinitz und Liebe.)
  Carbonformation und Dyas in Nebraska. (Geinitz.)
  Aphyllostachys. (Göppert).
  Die Fischzähne der Trias bei Jena. (Schmidt.)
  Zur Erklärung der Dolomit-Bildung. (Scheerer.)
  Die Untersuchung des Eisenmeteorits von Rittersgrün. (Winkler.)
  Die Plänerbildungen um Ortenburg bei Passau. (Gerster.)
  Das Erdbeben von Iquique. (Geinitz.)
  Die Blattinen aus der unteren Dyas von Weissig bei Pillnitz. (Geinitz.)
  Zur Erklärung der Bildung von Steinsalzlagern. (Ochsenius.)
  Zur fossilen Keuperflora. (Compter.)
  Die Basalte und Phonolithe Sachsens. (Möhl.)
  Tertiärpflanzen aus dem Leitmeritzer Mittel-gebirge. (Engelhardt.)
  Ueber die fossilen Pflanzen des Süsswassersandsteins von Tschernowitz. (Engelhardt.)
I. Jahres-Bericht der Geographischen Gesellschaft zu Greifswald.

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ASIA.

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Maps to accompany the above, under separate cover.
Irrigation Revenue Report 1881–2. N. W. Provinces.
Revenue Report, Public Works Department, Irrigation Branch, Bengal, 1881–2.
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Report on the Gold Mines of the South-east Portion of the Wynaad and the Carcoor Ghât, 1880.
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Records of the Geological Survey of India, Vol. xii., parts 2, 3, 4. ; Vol. xiii., parts 1, 2, 3, 4. ; Vol. xiv., parts 1, 2, 3, 4 ; Vol. xv., part 4 ; Vol. xvi., parts 1, 2, and 3.
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AUSTRALIA.

Victoria.

Result of Observations in Meteorology, Terrestrial Magnetism, &c., 1876.
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Notes on the Diabase Rocks of Buchan. (Howitt.)
Reports of the Board of Visitors to the Observatory, 1881, 1882.
Melbourne International Exhibition :—
  Official Catalogue.
  Official Record.
Eureka. (J. Wood Beilby.)
Ballaaratania.
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The Victorian Press Manual, 1882.

New South Wales.

Sydney Exhibition Catalogue.
On some Recent and Fossil Species of Australian Selenariadæ.
Journal and Proceedings of the Royal Society of New South Wales, 1878, 1879, 1880.
Report upon certain Museums of Technology, Science, and Art, 1879, 1880.
Report of the Department of Mines, 1878, 1879, 1881, 1882.
Maps to accompany the Report of the Department of Mines for 1879.
Report on the Australian Museum, 1881.
Australian Museum : Catalogue of Fossils.
Mineral Products of New South Wales.
The Minerals of New South Wales.
New South Wales in 1881.

South Australia.

The Geology of the Hundred of Munno Para. Parts 1 and 2.
Anniversary Address of the President of the Adelaide Philosophical Society, 1878, 1879.
Natural History of the Country around the Head of the Great Australian Bight.
Zoologica et Palæontologica Miscellanea.
Descriptions of some New Species of South Australian Pulmonifera.
On the Australian Tertiary Palliobranchs.
The Recent Marginellidæ of South Australia.
On the New Species of Belemnites and Salenia from South Australia.
Notes on the Correlation of the Coal-bearing Strata of South Australia, with a list of Coral Fossils occurring in the Colony.
Transactions and Report, Royal Society of South Australia. Vol. v., 1881–2.

Tasmania.

Maning's Tasmanian Directory, 1881–2.

Queensland.

Report of the Department of Mines, 1878, 1879.
Report on the Wild River and Western Tin Mines.
Geology of North Queensland.

New Zealand.

Control and Inspection of Mines (Report on), 1879, 1881, 1882.
Goldfields of New Zealand, 1879, 1880, 1881, 1882.
Report of Royal Commission, N.Z. University, 1879.
Annual Report on the Colonial Museum and Laboratory, 1879–80, 1881–2.
Palæontology of New Zealand. Part IV.
Geology of the Provinces of Canterbury and Westland.
Manual of New Zealand Mollusca.
Meteorological Report, 1880.
Manual of Indigenous Grasses.
Reports of Geological Explorations, 1879–80.
Transactions and Proceedings of the New Zealand Institute. Vol. XII., 1879; Vol. XIII., 1880; Vol. XIV., 1881.
Catalogue of Australian Stalk- and Sessile-eyed Crustacea.
Handbook of New Zealand, 3rd Edition.

GEOLOGICAL AND MINERALOGICAL COLLECTIONS,

PRESENTED TO THE DEPARTMENT OF MINES AS DONATIONS OR IN EXCHANGE FOR VICTORIAN SPECIMENS.

(From 1st July, 1879, *to 31st December,* 1883.*)*

Samples of Wood, Clay, Iron Pyrites, and Stream Tin, from Woolbrook Company's Mine, Carisbrook. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Sample of Impure Limonite, from Mount Arapiles. C. Smith, Esq., Mount Arapiles.

Samples of Bituminous Shale, from Traralgon. J. Peterkin, Esq., Traralgon.

Sample of Stibnite, from near Jamieson. J. Fox, Esq., Jamieson.

Samples of Quartz Conglomerate, Kaolin, and Fossil Leaves in Clay, from Mein's Freehold Company's Mine, Guildford. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Sample of Bituminous Shale, from Traralgon. C. F. Chapman, C. L. Bailiff, Traralgon.

Samples of Titaniferous Iron Sand, Lithomarge, and Quartz containing Metallic Lead, from Anderson's Creek. R. E. England, Esq., Melbourne.

Sample of Quartz traversed by Manganese, from near Violettown. H. Linard, Esq., Violettown.

Sample of Limonite, from Rushworth. H. Hicks, Esq., Mining Registrar, Rushworth.

Samples of Micaceous Iron Ore and Cement, from Boggy Creek. J. Fletcher, Esq., Mining Registrar, Boggy Creek.

Sample of Gabbro, from Working Miners' Company's Mine, Homebush. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Samples of Impure Arsenic and Oxide of Iron, from the Pyrites Works, Castlemaine. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Samples of Copper Pyrites, from Thomastown. J. E. Fetherston, Esq., Thomastown.

Sample of Quartz associated with Tourmaline. R. Arrowsmith, Esq., Mining Registrar, Chiltern.

Samples of Quartz and Scrodite, from the Wentworth River, Gippsland. A. G. Wail, Esq., Waterford.

Sample of Marble, from the Limestone River, North Gippsland. A. J. Agg, junr., Esq., the University.

Samples of Psilomelane and Brown Hematite, from Molesworth. J. W. Sloane, Esq., Molesworth.

Sample of Fossiliferous Limestone, from near Mansfield. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Samples of Copper Pyrites and Roasted Ore, from Budgee, Gippsland. J. Robinson, Esq., Sale.

Samples of Fossiliferous Conglomerate and Dyke Stone, from Lillydale. Jas. Lowe, Esq., Lillydale.

Samples of Vesicular Phonolyte, Granular, and Hornblendic Rocks, from Coleraine. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Samples of Dense Serpentine and Schistose Rock, from Glenelg River; and Vesicular Basalt, from Wannon Falls. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Samples of Psilomelane, Happy-go-Lucky, Gippsland. J. Brache, Esq., Melbourne.

Fossil Fruits, from Eldorado Lead. H. Davidson, Esq., Mining Surveyor, Beechworth.

Samples of Metallic Iron and Siliceous Clay and Oxide of Lead, from Smythesdale. Smith Tibbitts, Esq., Linton.

Samples of Quartz and Mica, from near Glenrowan. A. L. Ely, Esq., Wangaratta.

Metals containing Metallic Lead, Iron, Copper, and Zinc, from Linton. Smith Tibbitts, Esq., Linton.

1894.

VICTORIA.

Samples of Antimony Ore, from the Bristol Hill Company's Mine, Maryborough. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Sample of Aragonite, from the Richmond Quarries. E. M. Cairnes, Esq., Mining Department, Melbourne.

Crystalline Pebbles of Pleonaste, from Corindhap. J. Lynch, Esq., Mining Surveyor, Smythesdale.

Samples of Psilomelane, from Walhalla. Hon. L. L. Smith.

Samples of Tin Ore, from Beenak. J. G. Shelley, Esq., Beenak.

Samples of Auriferous Quartz and Amalgam, from Swift's Creek, near Omeo. A. W. Howitt, Esq., P.M., Sale.

Samples of Brown Iron Ore (Limonite), from Glenmaggie. A. McLean, Esq., M.P.

Samples of Arsenical and Iron Pyrites, Basalt, Olivine, Calcite, Quartz, Crystals of Calcite and Quartz, Brown Iron Ore, and Red Oxide of Iron, from some of the principal mines at Sandhurst. Caleb Thomas, Esq., Surveyor, Sandhurst.

Sample of Micaceous Diorite, from Walhalla. A. W. Howitt, Esq., P.M., Sale.

Samples of Marcasite, Micaceous Sandstone, Brown Coal, Lignite, Fossil Resin (Retinite), Iron Pyrites, Magnesian Clay and Basalt, from Bruthen Creek, near Woodside, South Gippsland. T. H. Lucy, Esq., Woodside.

Yellow Copper Ore (Chalcopyrite), from near Yarrawonga. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Titaniferous Iron Sand, from Gembrook. The Editor of the *Leader*.

Sample of Hydrous Silica—a variety of Opal—from Bowman's Forest. A. W. Smart, Esq.

Titaniferous Iron Sand, from Gembrook. Thomas McCormick, Gembrook.

Sapphires, from Garlick's. T. Robson, Esq.

Samples of Gypsum and Clay Slate, from the Goldbrook Company's Mine, Maryborough. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Samples of Earthy Manganese Ore (Wad) and Calcareous Grit containing Oxide of Manganese, from near Yea. R. Murchison, Esq.

Gem Stones (Zircons), from Amphitheatre. J. Weir, Esq., Elmhurst.

Sample of Marl, from Toongabbie. J. Buntine, Esq., Toongabbie.

Samples of Psilomelane, from Jan-Juc. R. J. Murchison, Esq., Jan-Juc.

Sample of Titaniferous Sand, from Corryong Creek. P. Guilfoyle, Esq.

Manganese Ore (Wad), from Molesworth. D. McWaters, Esq., Fitzroy.

Samples of Tin Sand, from Tributaries of the Little Yarra. T. Quinn, Esq.

Sample of Tin Sand, from La Trobe River. T. E. McCarthy, Esq.

Iron Pyrites replacing Fossil Wood, from Nindingbool Estate, Linton. Smith Tibbitts, Esq,, Smythesdale.

Samples of Diorite, Shale, and Quartz, from the King River. J. Kiely, Esq.

Samples of Clay, Limestone, and Gypsum, from Maryborough. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.

Pitch-Stone, from near Mount Stavely. R. C. Carr, Esq., Department of Mines, Melbourne.

Samples of Rock containing Dendritic Markings. J. Stirling, Esq., Omeo.

Samples of Stream and Lode Tin, from Tasmania. R. Bradford, Esq., Department of Mines, Melbourne.

Samples of Chromic Iron Ore and Serpentine Rock, from Gippsland. A. McLean, Esq., M.P.

Samples of Manganese Ore, from near the Little Yarra. Thos. Gilroy, Esq., Lillydale.

Samples of Washdirt and Gold, from Mirboo, Tarwin River. W. Gray, Esq., Melbourne.

Aluminous Clay, from the Great Northern Company's mine, Sandhurst. G. N. Craig, Esq., Sandhurst.

Fossil Specimen (Sphenopteris), from Moe. Mr. Attwood, Moe.

Cobaliferous Manganese, from Warburton. J. Glover, Esq., Melbourne.

Sample of Stream Tin, from the head waters of the Acheron River. J. F. Green, Esq., Fitzroy.

Brown Iron Ore, from Yarrawonga. W. J. Carlisle, Esq., Yarrawonga.
Samples of Iron Ore containing Pyrites, from Walhalla. Mr. Black.
Sample of Tin, from the Acheron River. D. McWalters, Esq., Melbourne.
Samples of Tin Ore, from Jingellic. W. Schlichting, Esq., Collingwood.
Samples of Quartz and Iron Pyrites, from Russell's Creek. A. E. Moore, Esq., Melbourne.
Sample of Tin Sand, from Malmsbury. H. B. Nicholas, Esq., Senior Inspector of Mines, Castlemaine.
Pyrites from Sandhurst. J. Quick, Esq., M.P.
Samples of Iron Ore, from the Grampians. W. Sheffield, Esq., Wickliffe.
Sample of Coal, from Skipton. Hon. F. Longmore.
Titaniferous Iron Sand, from Fern-tree Gully. Hon. L. L. Smith.
Titaniferous Iron Sand, from Cunninghame. A. W. Howitt, Esq., P.M., Sale.
Collections of Specimens of Siliceous Breccia enclosing fragments of Garnierite, Laminated Compressed Noumeaite, Garnierite, Pale Garnierite, Serpentine, Serpentine Breccia, Noumeaite, Pale Noumeaite, Compressed Serpentine, Magnesian Hydro-silicate, Mammillated Noumeaite, Nickeliferous Hydro-silicate, Breccia, Siliceous Breccia and Nickeliferous Serpentine, from various parts of New Caledonia. F. Ratti, Esq., School of Mines, Ballarat.
Sample of Psilomelane, from near Walhalla. F. Richards, Esq., Melbourne.
Samples of Basalt, from the Summit of Mount Useful. H. W. Ford, Esq.
Pyrites, from Briagolong. A. W. Howitt, Esq., P.M., Sale.
Samples of nearly pure Sulphide of Antimony, from Blackwood. J. F. Hansen, Esq., Mining Registrar, Blackwood.
Oxide of Antimony, from Ringwood. J. Finnie, Esq., Richmond.
Pyritous Quartz, from Mount Greenock. R. A. F. Murray, Esq., Geological Surveyor, Talbot.
Samples from the Gippsland Marble Company, Toongabbie.
Samples of Pyrites, from Stawell. W. Cahill, Esq., Stawell.
Samples of Arsenical Pyrites (highly auriferous) and Serpentine, showing Gold, from the Reform Gold Mining Company's Mine, Lucknow, N.S.W. H. W. Newman, Esq., Lucknow.
Tourmaline, from Bright. B. K. Smart, Esq., Mining Registrar, Bright.
Samples of Fossil Wood impregnated with Iron Pyrites and Fossil Fruit, from Haddon. Smith Tibbitts, Esq., Smythesdale.
Samples of Titaniferous Iron Sand, from Dandenong. F. Johnson, Esq., Windsor.
Titaniferous Iron Sand, from the head of the Mitta Mitta River. Hon. G. V. Smith, Melbourne.
Quartz Tailings, from Sebastopol, Lerderderg River. J. F. Hansen, Esq., Mining Registrar, Blackwood.
Quartz Tailings, from Dargo. A. W. Howitt, Esq., P.M., Sale.
Specimens of Wolfram, from Linton; and Fossil Leaves in Clay, from Haddon. F. M. Krause, Esq., F.G.S., Ballarat.
Crude Sulphur and Graphite, from the Mallee. C. E. Findlay, Esq., Lockhart.
Tin Ore, from Black Mountains. Mr. H. Mackenzie.
Auriferous Quartz, from the Koh-i-noor Mine. J. F. Hansen, Esq., Mining Registrar, Blackwood.
Manganese Ore, from the Acheron River. H. W. McLellan, M.P.
Fossil Plants of the Lepidodendron Group, from the Mansfield District. R. A. F. Murray, Esq., Geological Surveyor, Talbot.
Samples of Quartz and Arsenical Pyrites, from near the head waters of Koetong Creek. M. Collins, Esq., Bethanga.
Samples of Manganese and Sulphide of Antimony, from Sunday Creek. E. M. Cairnes, Esq., Mining Department, Melbourne.
Samples of Ferruginous Clay with Iron Pyrites, from Dunmunkle. Shire Secretary, Dunmunkle.
Auriferous Quartz, from Messrs. Croker Brothers' claim, Whipstick Creek. J. F. Hansen, Esq., Mining Registrar, Blackwood.

Pleonaste with Zircons, from Jindivic. F. C. Mason, M.P.

Sample of Metallic Antimony, from near Mansfield. B. Smith, Esq., P.M., Mansfield.

Stream Tin, from Bishop's Creek. Hon. W. McLellan, M.P.

Jamesonite (Sulphide of Lead and Antimony), from Buchan. Hon. W. Madden, M.P.

Samples of Kaolin (suitable for the manufacture of earthenware, &c.), from Mirboo. G. Goldsmith, Esq.

Specimens of Granite, from Cape Wollomai. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Samples of Limestone and Lignite, from the Bore-hole at Williamstown. Hon. A. T. Clark, M.P.

Samples of Auriferous Pyrites, from Bethanga and Granya. Hon. G. V. Smith, Melbourne.

Specimens of Syenite and Dyke Stone, from the vicinity of Nugety Gully ; Felspathic Dyke, from the vicinity of Dunach and Mount Glasgow ; and Syenite, from Long Gully. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Samples of Clay, Limestone, and Pyrites, from the Bore-hole at Williamstown. J. M. Barr, M.P.

Pyrites, from Merriman's Creek. C. Lawler, Esq., Sale.

Samples of Quartz, Quartz Felspar, Schorl Rock, Orthoclase, and Gneissose Schist, from near Albury ; Pyritous and Fossiliferous Sandstone, from Reedy Creek ; Quartz and Mica Schist, from Mount Moliagul ; Tin Sand, from Beechworth ; Gold on Granite, Quartz, Rock Crystals, and Cherts, from near Frankston ; and Mica Schist and Granite, from Arthur's Seat Ranges. J. Wood Beilby, Esq., Brighton.

Samples of Copper Ore, Quartz Breccia, Granitic Breccia, Ferruginous Sandstone and Ironstone, from the You Yangs. The Editor of the *Leader*.

Iron Pyrites, from N.W. of Foster. W. R. Kissane, Esq., Melbourne.

Auriferous Quartz, from Union Jack Reef, Gippsland. A. W. Howitt, Esq., P.M., Sale.

Samples of Manganese Ore and Micaceous Iron Ore, sent by H. McColl, Esq., M.P.

Magnetic Pyrites with traces of Silver and Copper, from Howqua River. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Samples of Lode Tin, from Mitta Mitta District. C. W. Langtree, Esq., Mining Department.

Samples of Fossiliferous Limestone, from Stony Creek, Gippsland. J. Stirling, Esq., Omeo.

Iron Pyrites, from the Upper King River. Messrs. J. & H. Tyrrell, Upper King River.

Quartz, from Chiltern. J. O. M. Manly, Esq., Chiltern.

Quartz impregnated with Carbonate of Lime, from Adelong, N.S.W. J. T. Cole, Esq., Melbourne.

Auriferous Quartz, from Chiltern. W. H. Martin, Esq., Chiltern.

Iron Ore, sent by the Hon. L. L. Smith.

Samples of Auriferous and Argentiferous Quartz, from Granya and Bacchus Marsh ; and Copper Ore, from Millewa. H. Sinclair, Esq., Melbourne.

Specimen of Marl, sent by Hon. J. H. Graves, M.P.

Sample of Quartz containing Gold, Silver, and Pyrites, from Howqua Hills. J. Rowe, Esq., Howqua Hills.

Calcareous Clay, from Yerang. D. S. Walker Esq., Yerang.

Sample of Graphitic Schist containing Iron Pyrites, Gold, and Silver, from Stawell. R. Stirling, Esq., Melbourne.

Sample of Argentiferous Quartz, from the junction of the Delatite and Goulburn Rivers. A. B. Ainsworth, Esq., Mining Surveyor, Alexandra.

Samples of Secondary Iron Pyrites, from near Colac. J. H. Connor, Esq., M.P.

Manganese Ore containing Cobalt, from Gippsland. R. Winter, Esq.

Chromic Iron Sand, from Mansfield. Shire Council of Mansfield.

Carbonate and Phosphate of Lead (Argentiferous), from Omeo. H. Foster, Esq., Omeo.

Micaceous Quartz Sand from Carr's Flat, Bruthen; and Clay mixed with Organic Matter, from Woodvale. The Editor of the *Leader*.

Sample of Argentiferous Auriferous Quartz, from the Pole Star Reef, Omeo. A. W. Howitt, Esq., P.M., Sale.

Sample of Argentiferous Quartz, from Howqua Hills. Hon. J. H. Graves, M.P.

Sample of Coal, from Hazlewood. R. A. F. Murray, Esq., Geological Surveyor, Talbot.

Sample of Pyrites, containing Copper and Silver. H. McColl, Esq., M.P.

Samples of Earthy Carbonate of Iron containing Silver, from Hawthorn Creek, Tanjil. Herrman Rathke, Esq.

Sample of Limonite, from Howqua. Howqua Shire Council.

Sample of Fine-grained Manganese Ore containing Cobalt Oxide. T. Brentman, Esq., Melbourne.

Samples of Carbonaceous Shale containing Iron Pyrites, from Bowman's Forest. A. W. Smart, Esq., Murmungee.

Samples of Quartz, from Crossover Diggings. James Neysey, Esq., Crossover Diggings.

Sample of Auriferous Iron Pyrites, from Omeo. A. W. Howitt, Esq. P.M., Sale.

Sample of Magnetic Oxide of Iron, from Bruthen. A. W. Howitt, Esq., P.M., Sale.

Specimen of Ore, from Bethanga. W. Schlichting, Esq., Bethanga.

Sample of Clay, from Stawell. W. Cahill, Esq., Stawell.

Samples of Galena, from Snowy River. A. W. Howitt, Esq., P.M., Sale.

Samples of Lake Deposits, from the Wimmera District. Hon. W. Madden, M.P., Melbourne.

Sample of Auriferous Argentiferous Ore, from Gippsland. Messrs. Law, Somner, and Co., Melbourne.

Sample of Auriferous Quartz, from the Dark River. W. McTaggart, Esq.

Sample of Iron Glance, from the Western District. T. Hunt, Esq., M.P.

Sample of Auriferous Argentiferous Ore, from Bacchus Marsh. H. Sinclair, Esq., Melbourne.

Sample of Limonite, from Darlingford. Messrs. Kelly and Dunn, Darlingford.

Sample of Limonite. J. Brache, Esq., Northcote.

Sample of Carbonaceous Clay, from North Walhalla. W. M. Smith, Esq., Mining Registrar, Walhalla.

Sample of Argentiferous Quartz, from Deptford. A. W. Howitt, Esq., P.M., Sale.

Sample of Auriferous Iron Pyrites. Editor of the *Leader*.

Oyster Shell attached to Quartz, from the S.E. Coast. D. M. Davies, Esq., M.P.

Sample of Calcite. W. Anderson, Esq., M.P.

Sample of Galena, from Rushworth. T. Hunt, Esq., M.P.

Collection of Ores, from Bethanga. C. C. Rawlins, Esq.

Sample of Coal, from Casterton. L. D'Amaras, Esq.

Samples of Auriferous and Argentiferous Quartz and Serpentine Rock, from Mount Bulla. Hugh Cameron, Esq.

Sample of Quartz, from Avenel. Isaac Bell, Esq., Avenel.

Sample of Clayey Slate, from Crossover Diggings. P. J. Devine, Esq., Crossover.

Sample of Auriferous and Argentiferous Quartz, from Doogalook. R. Murchison.

Sample of Quartz and Iron Pyrites, from Grant. A. W. Howitt, Esq., P.M., Sale.

Sample of "Noutronite" (Hydrated Silicate of Iron). Editor of the *Leader*.

Sample of Auriferous and Argentiferous Quartz with Iron Pyrites, from Beechworth. Messrs. Sinclair and McCracken, Melbourne.

Samples of Serpentine Slate and Black Sand, from a Bore at Heathcote. J. M. Speed, Esq., Heathcote.

Samples of Carbonaceous Clay containing Fossil impressions and Siliceous Sponge Spiculæ, from Davy Point, near Frankston. B. C. Harriman, Esq., Melbourne.

Samples of Fire Clay, from South Gippsland. Hugh Sinclair, Esq., Melbourne.

LIST OF GOLD NUGGETS FOUND IN VICTORIA FROM 1ST JULY, 1879, TO 31ST DECEMBER, 1883.

(Showing the localities where found, the date of discovery, the name of the discoverer, the weight, and the depth at which each nugget was obtained.)

Locality, and by whom found.	Date of Discovery.	Gross Weight (Troy).				Depth at which found.	
		lb.	oz.	dwt.	gr.	ft.	in.
Found at Garden Flat, Majorca, by Messrs. Rowe and Milligan	24th July, 1879	7	9	14	0	18	0
Found at Whipstick, by J. Henston	10th September, 1879	3	19	0	0	Not stated	
Found at Wedderburn, by Cornelius Mahoney	19th September, 1879	1	7	7	0	4	0
Found at Green Hills, near Stawell, by James Kahrans	13th December, 1879	3	4	13	0	40	0
Found at Mia Mia, by Robert Catherwood	29th January, 1880	1	6	4	6	1	6
Found at Homebush, in the mine of the Working Miners' Company	24th March, 1880	6	8	0	0	170	0
Found at Taradale, in the mine of the Little Wonder Company	26th March, 1880	2	2	9	0	140	0
Found at Taradale, in the mine of the Little Wonder Company	3rd April, 1880	9	3	19	0	140	0
Found at Brown's, in the Ballarat district, in the mine of the Golden Age Co-operative Company	8th April, 1880	6	3	12	12	150	0
Found at Christmas Reef, Raywood, by Mark Phillips	10th June, 1880	5	1	0	0	7	0
Found at Wedderburn, by James Lang	26th June, 1880	1	4	2	0	4	0
Found at Scotchman's Gully, Whipstick, by James Rossen and Robert George McDonnell	5th July, 1880	1	0	11	12	9	0
Found at Shicer Gully, Wedderburn, by Philip Archer	9th August, 1880	8	3	0	0	13	0
Found at Tambourine Gully, Wedderburn, by Robert Willis	13th August, 1880	3	3	0	0	2	0
Found at Tarnagulla, by Messrs. Boan and Morton	13th August, 1880	4	4	0	0	Surface	
Found at Wedderburn, by H. Kropp	4th September, 1880	3	4	7	0	3	0
Found at Wedderburn, by R. Henderson	7th September, 1880	0	10	6	0	5	0
Found at Wedderburn, by Thomas Hillyer and Christopher Reust	14th September, 1880	1	2	5	0	3	6
Found at Pickpocket, Yandoit, by Ah Fee and party	October, 1880	0	10	10	0	10	0
Found at Dunolly, by Thomas Costello and another	29th October, 1880	2	5	0	0	42	0
Found at New Nuggety Gully, Yandoit, by G. Vinecombe and party	31st December, 1880	6	0	0	0	15	0
Found at Inglewood (finder's name not divulged)	January, 1881	16	9	16	0	Not stated	
Found at Little Bendigo, Ballarat, by a party of Chinamen	14th January, 1881	5	0	10	0	25	0
Found at Wedderburn, by Edward Jones	1st March, 1881	1	8	16	0	3	6

List of Gold Nuggets found in Victoria, etc.—*continued.*

Locality, and by whom found.	Date of Discovery.	Gross Weight (Troy).				Depth at which found.	
		lb.	oz.	dwt.	gr.	ft.	in.
Found at Boort, by the children of a selector named Peterson	18th July, 1881	5	1	0	0	Surface	
Found at Dunolly, by Peter Miller and another	26th July, 1881	7	8	0	0	15	0
Found at Homebush, in the mine of the Working Miners' Company	21st July, 1881	8	5	0	0	165	0
Found at Old Dunolly, by William Rogers	14th September, 1881	7	2	18	5	7	0
Found at Old Inglewood, by Francis Hase and William Brooker	2nd November, 1881	5	11	0	0	18	0
Found at Caledonia Flat, by Messrs. J. Beattie and J. Hoase	6th December, 1881	10	11	0	0	7	0
Found at Talbot, in the mine of the Hoffnung Gold Mining Company	16th January, 1882	2	10	3	0	90	0
Found at Creswick, in the mine of the Madame Berry Gold Mining Company	31st January, 1882	6	3	5	0	475	0
Found at Rheola (Berlin) (finder's name not divulged)	9th February, 1882	9	1	6	0	Not stated	
Found at New Nuggety Gully, near Yandoit, by Brenton and Company	23rd June, 1882	7	8	0	0	14	0
Found at Nuggety Gully, Gobur, by Frederick Mundy	27th May, 1883	1 0	1 1	4 10	0 0	Surface	
Found at Wedderburn, by Henry Smye	13th June, 1883	1	7	9	0	2	0
Found at Sawpit Gully, Kingower, by Simon Stephens	18th June, 1883	16	5	0	0	2	0
Found at Paddy's Gully, Wedderburn, by John Anderson	12th July, 1883	1	2	6	0	1	6

1894.

VICTORIA.

LABORATORY REPORT.

By J. Cosmo Newbery, C.M.G., B.Sc., Analyst.

Technological Museum,
Melbourne, 31st December, 1883.

Sir,

I have the honour to submit a list of the specimens examined by me since the date of my last Report, together with some notes which, I think, may be of general interest.

Our most important mineral or metallurgical question is, what is the best method of extracting the gold from our auriferous quartz-pyrites, quartz-tailings, or waste. The subject is occupying the minds of a large section of the community, and numerous new processes have been devised, suggested, and patented. Of several of these I have made some notes, which may be of interest, or aid those who are working in the matter.

The processes may be divided into classes :—

1. The amalgamation of the gold, liberated by the fine crushing of the auriferous quartz, so as to obtain that which is not retained by the ordinary appliances now in use, such as ripples, amalgamated copper plates, chilian mills, barrels, Wheeler's pans, &c.
2. Concentration, with the view of obtaining, in a small bulk, all the free gold which passes away with the tailings from the crushing mills, together with that which is either attached to or enclosed in quartz grains or pyrites.
3. The treatment of the concentrated material so as to separate the greatest possible amount of gold.
4. The treatment of the ore by some smelting process.

The first division has to deal with very poor material, in which, for the most part, the minute particles of gold are enclosed in grains of quartz and pyrites, or such minerals as have been formed by the natural decomposition of the pyrites. The term "pyrites" is not limited to its strict mineral meaning, but is used on our gold-fields not only to denote the sulphide of iron but includes all mixtures of iron arsenical or copper pyrites, galena, zinc-blende, and other sulphides and arsenides. To be successful, an amalgamating process must be preceded by crushing, or grinding in some machine more efficient, though not more costly, than the stamping battery, so as to break up the fine sand grains which have already passed through gratings punched with 120 holes to the inch, and which, on an average, are not more than $\frac{1}{20}$th of an inch in diameter. That this can be done was demonstrated some years ago by Mr. Henry Rosales, at Walhalla, but he was working with concentrated and comparatively rich material, very different from the ordinary tailings of such districts as Sandhurst, Clunes, Ballarat, or Stawell. The inventors in these divisions do not seem to have thoroughly investigated the requirements of the case, and therefore failure follows failure. There is, no doubt, a great deal of gold remaining in our tailings heaps, but each ounce is divided into very minute grains, and each is locked up in very small grains of quartz distributed through some four or five tons of tailings. I do not think that more than 4 or 5 dwts. of gold will be found in any quartz-tailings where modern machinery is in use, and where the quartz has been free from pyritous minerals ; and at the more complete plants the amount is less—probably from 2 to 3 dwts. per ton.

Still, when an attempt is made to estimate the gold-value of the tailings of such a district as Sandhurst, the figures become very large. Since 1860, some five or six millions of tons of quartz have been crushed, and if 4 or 5 dwts. per ton have been left in the quartz this would give a value of £5,000,000 worth of gold on or about the surface of Sandhurst, which, with our present appliances, cannot be profitably extracted. Where gold is locked up in mineral matter heavier than quartz, there is a good field for those who are introducing scientific ore-dressing machinery, and they will, at the same time, collect any free gold and the quartz grains which contain sufficient gold to materially effect their weight. It is more than twenty years since my late colleague, Professor Ulrich, now of the University of Otago, tried to introduce into Victoria scientific ore-dressing machinery. Since that time, hardly a year has passed without some one following his example. Yet, strange as it may seem, up to the present time a good ore-dressing plant does not exist in Victoria. I do not mean to say that there are not good plants, doing all that is required of them, but where refractory or complex ores occur there is great waste of very rich material, and plenty of room for the introduction of true ore-dressing machinery, and it should pay handsome profits. The only reason that can be suggested to account for the repeated failures in the attempts to introduce such machinery is, that the machines are based on purely scientific principles, and cannot be worked unless perfectly understood; and that, as a rule, the physical sciences have not been taught where our miners have been educated, either here or in Great Britain. Perhaps our mining schools at Sandhurst and Ballarat may meet this want, and remove the difficulty. Whether this suggested reason is true or not, it still remains a fact that thoroughly good proved machines have been imported and erected on several of our gold-fields, and have always been abandoned and condemned as worthless by our otherwise intelligent miners. Simple contrivances and machines, such as blanket-tables, strakes, the common shaking-tables, Munday's buddles, &c., which need no special knowledge, are to be found all over the country, working as well as is possible with the quality of material passed over them. In support of the claim for consideration for scientific machinery, I may point to the marked change in the results obtained at the Mount Bischoff tin mine, in Tasmania, when this machinery was introduced, for it is an excellent example. With the usual ordinary appliances, this mine was on the point of either being closed or given up to tributors when Mr. Kayser introduced the new or scientific system, and, as is well known, this mine is now holding the premier position amongst the tin mines of the world, and is treating an ore yielding on an average less per ton than any other profitable mine in Australasia.

The processes now in use for the treatment of the concentrated ores are, practically, two. 1. Roasting and amalgamation, or roasting and chlorination. Both, with proper care and suitable ores, give very good returns, but there are objections to both processes, and circumstances under which they must both fail. The chief objection is one of cost, and they fail with ores containing much galena or sulphide of antimony. In both, the ore enclosing the gold must be so altered that either the mercury in the amalgamators or the chlorine in the vats may reach the gold, and for this purpose the ore is roasted in reverberatory or revolving furnaces, where the sulphur and arsenic are expelled, and the iron with which they were in combination is converted into an oxide; but most of our furnaces are but crude contrivances. The best of them will not completely oxidize a charge of ore in less than 12 or 14 hours, while it is an easily-demonstrated fact that any single grain of the charge may, if exposed to a current of air at a dull-red heat, be completely oxidized in one minute—and if one grain may be so dealt with, why not any number? The difference between this and the ordinary roasting in the reverberatory furnace is simply the want of air. Experiments show that pyrites, even when strongly heated, will not part with the last portion of its sulphur in an atmosphere in which there are impurities or reducing gases in such proportion that ordinary combustion will not take place, and this condition exists over the major portion of the beds of our reverberatory furnaces, and to some extent in the revolving furnaces.

In order to hasten the work in the furnaces, the temperature is often raised above a dull-red heat, with the result that a hard, black magnetic oxide of iron is produced, or with mixed ores still more refractory compounds, in place of a soft, spongy, red oxide of iron. When magnetic oxide of iron is formed, the grains of sand contract and become intensely hard, and the gold is locked up more thoroughly than it was in the original pyrites, and neither mercury nor chlorine can possibly get at it. Knowing the cause of slow and bad roasting, it should not be difficult to devise a furnace that should admit the necessary quantity of heated air, and at the same time allow an immediate exit for the products of combustion and the volatile ingredients from the oxidized ore.

Various processes have been tried, with more or less success, during the past two or three years. They have included—

1. Smelting, as in copper-works, for a regulus, but this had to be abandoned owing to the exorbitant charges made in England for the treatment, though the regulus sent often contained—gold, 21ozs. 18dwts. 23grs. per ton ; silver, 30oz. 6dwts. 9grs. per ton ; copper, 55 per cent.

2. A process, in which the pyrites was roasted with an addition of salt, so as to render the copper soluble—washing out this copper salt with water, amalgamating the residue, and, after extracting the gold, reducing the ferruginous residue, forming a spongy iron, with which to remove the copper from solution. On a small scale, this process worked well, but did not prove successful at Bethanga, owing, I think, to the production of magnetic oxide of iron, which was rendered more refractory by being glazed by the salt.

3. A process of partial roasting, so as to produce as much sulphate of copper as possible, then washing, grinding, and re-roasting the residue, and subsequent amalgamation. At the outset, this process was successful on a large scale, but ultimately failed, partly from the same bad roasting.

4. Next we have a process in which the intention was to liberate the gold, no matter how the roasting was conducted, by fine grinding. The roasted ore was passed between the mill-stones of the ordinary flour-mill, then silk-dressed, the coarser particles being returned to the mills and re-ground. The gold in this operation seemed to be all liberated, but it was ground so fine, and was so dirty by having the hard, minute grains of oxide of iron pressed into it, that it was almost impossible to cause it to amalgamate. Other difficulties were also met with, and the process had to be abandoned before its merits could be perfectly tested.

5. A direct process, which promises well, has been devised for the treatment of Bethanga ore—a mixture of iron, copper, magnetic, and arsenical pyrites, with more or less galena and zinc-blende, containing silver as well as gold. In this process the ore is first burnt in large heaps to expel arsenic and some sulphur ; it is then, after passing through a stone-breaker, smelted in cupola furnaces, where a poor regulus is formed. This regulus then runs into a furnace so arranged that a blast of air may be passed through the molten mass, silica being added to take up the oxides formed, and make a slag, while the gold and silver are retained in a rich copper regulus ; this is then fused with lead to separate the gold and silver from the copper regulus, and ultimately the lead cupelled. Though only a few words are necessary to give an outline of this process, failure has followed failure in overcoming practical details, but now success seems to have been achieved, and a fairly cheap process provided for treating these poor, refractory ores.

It still remains to be seen whether roasting and amalgamation will be able to hold its own against this new process, and I am inclined to think that with some ores it will, especially if care is taken to get full value for the fuel used in the roasting furnace, to have all the sulphide of iron converted into red oxide, and to see that the gold is not coated with any film that will prevent its amalgamation. Several inventors claim to have attained perfection in these divisions, but their processes have not yet been proved on a large scale.

Next in order to the extraction of gold, comes the economical treatment of the ore from the tin-bearing quartz lodes of the Upper Murray. As with many similar mines in the other colonies, the methods adopted for dressing the ore, so as to make it suitable for the smelter, have not been sufficiently good or economical, and the mines are consequently unprofitable. At most, or nearly all the mines, the first thing has been to erect heavy stamping batteries, on just the same principles as are adopted at mines where gold is so saved, and the result is that the brittle tin ore has been made into a slime, and in a great measure washed away.

For most of our ores, it would be found much more profitable to abandon the batteries, and, after calcining the ore, pass it through a stone-breaker, separate what tin ore has been set free, and re-crush or disintegrate the classified ore. Calcination is to be recommended for most ores, as it renders the stone very friable, and very materially assists in liberating the tin stone ; but with some ores calcination may not be advisable, or, owing to a scarcity of fuel, it may be too expensive. Under these circumstances, it may be omitted without effecting the subsequent process, further than making the crushing and disintegration somewhat more difficult.

In order to place a method within the reach of even the smallest mines, I have suggested a system for classification, which may be carried out either with or without water, except in the final dressing of the classified ore. It has been pointed out that in my experiments an undue amount of finely-pulverized ore was produced in the disintegrator ; but it must be noted that my published results were from a first trial with a mill intended to crush bark, not ore ; and that even under such conditions the result was more coarse ore, and less slime, than has resulted from the use of any other appliance ; and with a properly arranged series of suitable mills, somewhat on the plan since adopted by Mr. A. Hope, the dressing of the ore will be made very simple after proper classification, and the advantage gained will be that some of the mines opened may be made profitable without waiting for the introduction of more scientific machinery, and going through the same experience as has already been mentioned when dealing with scientific ore-dressing machines in gold extraction.

Details of the processes referred to may be found in Captain Wageman's pamphlet, "The Treatment of Tin Ore in Europe," or in a paper read by me on the subject before the Royal Society of Victoria, 9/8/83.

Some of the Upper Murray tin ores have been difficult to smelt, owing to associated ores and minerals. Much might be done by hand-picking the stone as it comes from the mine, in order to separate a portion of these detrimental minerals. Up to the present time the following have been noted :—Arsenical, copper, and iron pyrites ; scorodite ; scheelite ; wolfram, rutile, and titaniferous iron.

Cobalt.—In a previous Report, I mentioned a process which had been carried out in the laboratory by Mr. M. Hills, in which our earthy manganese ores which contain cobalt were fused with such a proportion of silica as to make an easily-melted slag of silicate of manganese, at the same time adding a quantity of pyrites, so as to form a regulus, in which the whole of the cobalt is taken up. Since then, other and apparently cheaper processes have been devised, and one, which has been introduced by Mr. Herrenschmidt, deserves special mention. He grinds the ore to a fine powder, and then acts on it with a hot solution of sulphate of iron ; oxide of iron is thrown down, while sulphate of cobalt passes into solution with some sulphate of manganese, or, if necessary or desirable, the whole of the manganese as sulphate. The manganese and cobalt may then be separated by a simple process, both in a marketable condition. Should any of the deposits of earthy cobalt-manganese in the colony be found to be of any magnitude, this process will probably be introduced, as very poor ores may be cheaply treated.

COLOURS.

A number of experiments have been made in the manufacture of mineral colours, amongst which are—

Antimony White—A pigment with very great covering power, and, weight for weight, far superior to whitelead ; but it is inferior to whitelead as a drier. This pigment may be made economically from the poor refuse antimony ores of Costerfield, Ringwood, Sunday Creek, and other Victorian localities. Care is needed in the oxidation, or the product may be a crystalline powder of no value as a pigment, or the colour may be grey instead of white.

White paint of fair quality has also been made from barytes from Buchan, zincblende from St. Arnaud, and white silica paints with kaolins from Dunolly and Ringwood and the very silicious clay from Stawell.

The ferruginous clays of Ballarat, Sandhurst, Phillip Island, and the residues from the pyrites works of Clunes, Sandhurst, and Castlemaine, yield a number of colours, including venetian red, indian red, purple, purple browns, umbers, and ochres.

An excellent orange-green has been made from the chalco-pyrite of Bethanga.

Blue from the cobalt of the Upper Yarra, and yellow from orpiment from arsenical pyrites.

CLAYS.

A number of practical tests and trials have been made to ascertain the value of our finer clays for the manufacture of china, porcelain, and the finer varieties of earthenware. Difficulties were met with in finding local substitutes for flint and felspar. For the former we have successfully used the harder portions of the infusorial earth-bed occurring at Talbot, the silicious sand from Stawell, and the dense, decomposed silico-felspathic rock from the shore of Port Phillip, near Frankston; while for felspar, a very good substitute may be made by the addition of alkalies to the pure white clay from Ringwood. Some of the articles produced by Mr. C. A. Mills have met with very general approval.

ARTIFICIAL STONE.

An artificial stone, now commercially manufactured at Sandridge from sand, clay, and lime, will, besides being an excellent building material, I am satisfied prove of great use in furnace building, as it may be made extremely refractory, and may either expose an acid or basic surface, as may be required.

BRITTLE WIRE WINDING-ROPE.

Attention having been called to the wire rope in certain mines becoming suddenly brittle, I have made a number of experiments and tests, and find that ordinary sound wire-rope, if exposed to a slightly acid solution of common salt in water, quickly becomes brittle. If a concentrated solution is used, acidified with a few drops of sulphuric acid, the rope will lose as much as $\frac{19}{20}$ths of its strength in less than one hour. The change in the iron seems to be physical, or that it has absorbed hydrogen. Several careful analyses failed to detect any absorbed acid, after the wire had been well washed and dried; and the wire returned to its normal condition if heated.

Many of our mine waters are very saline, and where pyrites is decomposing would be liable to contain sulphuric acid or acid sulphates. Where this is noted, special care should be taken to keep the rope well covered with grease and tar.

ASSAYS AND EXAMINATIONS.

Since the last Report, 385 assays and examinations have been made, amongst which the following are of interest:—

TIN SANDS.

Locality.	Percentage of Tin.
Beenak	63
Tarwin River	10*
Carryong, Upper Murray	67
Pioneer Creek	48·5
Little Yarra	55
Latrobe River	56
Acheron River	60
Bunyip River	62
Bishop's Creek	76
Beechworth	73
Koetong Creek	35·5
Koetong Creek	66
TIN STONE FROM QUARTZ LODES.	
Alfred Company, Upper Murray	66
Alfred Extended, Upper Murray	35·5
Wolwa, Upper Murray	21
Alfred, Upper Murray, washed ore	67·5
Alfred, washed ore	66

* Associated with titaniferous iron.

ASSAYS AND EXAMINATIONS—*continued.*

IRON ORES.

Locality and Description.	Percentage of Iron.
Darlingford—Limonite	59·9
Millewa—Iron glance	70
Bruthen—Magnetic oxide	72
Grampians—Iron glance	70
Yarrawonga—Limonite	58·7
Glenmaggie—Limonite	56
Rushworth—Hematite	70

GOLD AND SILVER ORES.

No. of Sample.	Locality and Description.	Gold per Ton.	Silver per Ton.
		oz. dwt. gr.	oz. dwt. gr.
5138	Tabbart, Gippsland—Secondary Iron Pyrites	traces	traces
5245	Sandhurst, Garibaldi Company—Concentrated Tailings	,,	,,
5260	Beenak—Secondary Iron Pyrites	,,	,,
5272	Dargo, Exhibition Reef—Sample from Barrels	33 6 0	,,
5309	English Australian Company—Concentrated Tailings	1 6 3	,,
5320	Russell's Creek—Iron Pyrites	traces	1 6 3
5322	...	9 2 22	...
5323	...	16 6 16	...
5394	Briagolong, See-it-Out Reef—Iron Pyrites and Free Gold	73 0 0	...
5414	Dargo—Tailings—Quartz Pyrites with Free Gold	9 16 0	...
5438			
5440	Iron Pyrites	traces	0 7 19
5454	Bethanga ,,	4 19 11	...
5455	,, ,,	2 5 17	...
5456	,, ,,	1 9 4	...
5467	,,	...	...
5485	Foster ,,	...	0 6 12
5488	Granya—Tailings, containing Iron Pyrites	7 7 3	...
5513	Upper King River—Iron Pyrites	traces	...
5188	Swift's Creek—With Carbonate of Lead	...	1 2 0
5301*a*	Stawell, Crown Cross Reef—Drill Core	0 3 6	...
5301*b*	,, ,, ,,	0 3 6	...
5305–8	Creswick—Drill Cores—Quartz and Clay Slate	...	...
5407AB	Sandhurst—Drill Core	0 6 12	0 16 0
5412	Lerderderg River—Quartz	...	0 16 0
5497	Tucker's Creek—Quartz	3 5 8	...
5517	Chiltern ,,	0 16 7	...
5519	Bacchus Marsh ,,	...	0 19 14
5421	Mount Firebrace ,,	0 6 12	0 19 14
5522	,, ,,	1 0 0	...
5532	Bacchus Marsh ,,	...	0 13 0
5533	,, ,,	...	0 9 0
5547	Omeo, Pole Star Reef—Quartz	0 9 19	1 2 17
5549	Howqua Hills ,,	...	0 16 8
5592	Gippsland ,,	0 3 6	0 16 0
5593	Dark River	0 19 14	1 2 1
5595	Bacchus Marsh—Quartz	0 15 15	0 10 12
	Dark River ,,	22 17 8	...
	St. Arnaud—Average Tailings	0 4 0	traces
5503	Howqua River, Chenery's Reef—Magnetic Pyrites	traces	...
5504	,, Near the above ,,	,,	...
5505	,, Between Lick Hole and Howqua—Magnetic Pyrites	,,	...
5523	Howqua Hills—Iron and Magnetic Pyrites	,,	traces
5524	,, Quartz and Pyrites	,,	1 19 0
5525	,, ,,	0 13 0	2 12 0

ASSAYS AND EXAMINATIONS—*continued.*

GOLD AND SILVER ORES—*continued.*

No. of Sample.	Locality and Description.	Gold per Ton.	Silver per Ton.
		oz. dwt. gr.	oz. dwt. gr.
5528	Stawell—Graphitic Schist with Pyrites	0 13 1	0 13 0
5533	Quartz and Iron Pyrites	traces	0 9 0
5537, 8, 9	Colac—Iron Pyrites : Secondary	...	...
5543	Sandhurst—Arsenical Pyrites	0 9 19	1 2 17
5547	Omeo, Pole Star Reef—Iron Pyrites	7 5 20	5 15 12
5549	Howqua Hills—Quartz and Pyrites	traces	0 16 8
5553	Benambra—Quartz, Copper, and Iron Pyrites ...	,,	2 2 0
5563	Crossover—Pyrites from Wash : Secondary ...	,,	traces
5579	Bethanga—Calcined Pyrites	0 17 14	3 4 0
	Granya—Pyrites Sand with Free Gold	42 8 22	...
	Beechworth—Iron Pyrites	0 14 8	...
	Bethanga—Regulus ... 68·86 per cent. of Copper	16 6 16	29 8 0
	,, ,, ... 58·5 ,, ,,	21 4 16	11 8 16
	,, ,, ... 38·6 ,, ,,	21 4 16	34 6 0
	,, Copper and Iron Pyrites	2 0 11	4 10 5
5599	Deptford—Quartz and Iron Pyrites	traces	traces
5604	Rushworth—Galena ... 49½ per cent. of Lead	...	112 7 11
5608	Mount Bulla—Quartz	2 5 17	1 12 16
5609	Avenel	traces	traces
5611	Doogalook—Quartz	0 6 12	0 9 19
5612	Grant	traces	traces
5614	Beechworth—Quartz and Iron Pyrites	0 13 1	9 2 23
5625	Mitta Mitta District—Copper and Iron Pyrites ...	1 6 3	0 13 0
5627	Gibbo River—Galena	...	7 3 0
5629	Dargo High Plains—Conglomerate	5 18 0	2 11 20
5630	,, ,, showing Free Gold	93 2 0	2 12 6
5631	Mitta Mitta District—Galena	...	...
5633	Bendoc—Galena ... ... 71 per cent. of Lead	...	13 1 8
5636	Mount Benambra	...	1 15 22
5638	Ranges North of Walhalla—Quartz	...	2 12 6
	St. Arnaud, Wilson Hill—Pyrites	4 4 22	10 2 13
	,, ,, ,, ...	3 5 8	5 10 16
	,, ,, ,, ...	1 12 16	11 2 3
	Ringwood—Pyrites Concentrated	0 10 10	2 4 21
	Howqua Hills—Quartz and Pyrites	2 2 10	2 13 14
	,, ,, ,, ...	2 8 23	2 7 1
	,, ,, ,, ...	1 12 16	1 12 16
	Stawell—Concentrated Blanketings	2 12 10	0 13 2
	Walhalla, Rising Sun Mine	16 19 17	...
	,, Long Tunnel Company—Pyrites	4 8 4	...
	Castle Reef, A 1 Company—Pyrites Concentrated ...	71 8 19	...
	Dunolly, Queen's Birthday	0 19 4	0 19 4
	Coy's Diggings, Black Cloud—Antimony Ore, 21 per cent.	1 15 22	0 13 2
	,, ,, ,, 16·2 ,,	1 6 3	0 19 14
	Ringwood—Antimony Ore ... 22 ,,	0 6 12	0 19 15
	Wood's Point—Pyrites	6 10 16	10 0 1
	Anderson's Creek ,, ...	1 15 4	...
	Ringwood Antimony Mine—Pyrites	0 17 14	...
	,, Antimony Ore, 67 per cent.	...	...
	,, Antimony Ore, 19 ,,	0 13 1	0 16 8
	Granya—Concentrated Tailings	42 8 22	...
	,, Pyrites	23 16 22	...
	St. Arnaud, Wilson Hill—Concentrated Pyrites ...	1 17 5	5 17 0
	Bethanga, Conne's Reef—Pyrites	9 6 4	2 18 9
	,, ,, Old Tunnel Pyrites ...	0 19 14	...
	Cotton-tree, Upper Murray—Pyrites	5 4 12	...
	Sandy Creek—Antimony Ore with Pyrites, 5 per cent.	3 14 2	...
	,, ,, ,, 20 ,,	2 5 17	...
	,, ,, ,, 17 ,,	4 11 11	...
	,, ,, ,, 5 ,,	1 6 3	...
	,, ,, South Stope, 27 ,,	1 12 16	...

Assays and Examinations—*continued.*

Gold and Silver Ores—*continued.*

No. of Sample.	Locality and Description.	Gold per Ton.	Silver per Ton.
		oz. dwt. gr.	oz. dwt. gr.
	St. Arnaud, Wilson Hill—Pyrites Sand	4 4 22	10 2 13
	" " "	3 5 4	5 10 16
	Moe Coal Seam—Pyrites	...	...
	Arcona—Sulphide of Antimony	2 5 17	...
	Wood's Point—Pyrites	36 11 17	...
	Stawell, Scotchman's Reef—Pyrites	0 13 1	...
	Ballarat, Band and Albion—Pyrites	5 4 12	...
	Bourke's Flat—Zinc-blende	...	3 15 18
	" "	...	4 18 0
	Sandhurst, Frederic the Great—Tailings	0 13 1	...
	Yarram—Secondary Pyrites	...	...
	St. Arnaud—Zinc-blende	traces	3 5 8
	Sale—Secondary Pyrites from Water Bore	...	...
	Granya—Pyrites	5 17 14	...
	Wood's Point—Pyrites	26 15 17	15 0 3
	Bethanga—Average assay from heap, 0·5 per cent. copper	2 12 6	1 12 6
	Cupola Regulus from above ... 5·6 " "	7 3 17	4 14 17
	" " 10 " "	9 11 16	6 9 0
	Slag from above ... ... 1·8 " "	0 3 0	1 2 0
	Slag from poor Cupola Regulus	0 1 0	0 16 0
	Bethanga—Calcined Ore ... ... 1·5 per cent. copper	3 2 0	2 18 0

Cement Tests for the Department of Public Works and Water Supply, showing Maximum Strength of Briqueter of a square inch section broken in lever machine.

	Alsen & Sons.	Star.	White's.	Knight Bevan.	Anchor.	Wouldam's.
Casks A.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1st Trial, after being made 7 days ...	200	275	300	285	285	355 400 12 months
Casks B.						
2nd Trial, after 7 days ...	270	355	335	395	390	
3rd Trial	330	...	450 12 months	...	395	
4th Trial	535 42 days old	500 12 months	...	550 90 days	450 18 days 545 90 days	

V545

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VICTORIA.

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1883.—Nos. 4, 24, 2. 1883.
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Notes on the Geology of Part of the Mitchell River Division of the Gippsland Mining District. By A. W. Howitt, F.G.S.
Notes on the Geology of the Ovens District, with Remarks on the Deep Leads. By A. W. Howitt, F.G.S.
Geological Survey of South-Western Gippsland. By Reginald A. F. Murray.
Geological Survey of Stawell. By Norman Taylor.
Notes on the Geological Survey of Ararat. By Ferd. M. Krausé.
Report on the Freestone Creek Deep Lead. By Reginald A. F. Murray.
Report on the Country intersected by the Durham Lead. By Robert Etheridge, F.G.S., and Reginald A. F. Murray.
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PROGRESS REPORTS.

REPORT ON WELCOME GULLY (NEAR DAYLESFORD) AND ROKEWOOD JUNCTION, TOGETHER WITH REMARKS AS TO "INDICATORS."

(*By R. A. F. Murray, F.G.S., Government Geologist.*)

I have the honour to report having visited Welcome Gully, near Daylesford, and Rokewood Junction, and inspected the mines wherein the recent rich gold discoveries have been made. These discoveries are not merely of local but of national importance, and though in districts widely apart, I report on them jointly, in order to emphasize the remarks which they call forth.

Welcome Gully is between 5 and 6 miles north-west from Daylesford, and is reported as having been rich in nuggety alluvial gold. It has been evidently well worked up to, but not beyond, a point near its head, where a large quartz reef crosses it. The gully, the alluvial workings, and the quartz reef are indicated on the geological map of Daylesford prepared from the survey by the late Mr. Norman Taylor.

For some time past Messrs. White and Jackson have been prospecting the large quartz reef with varying success, but only lately has the discovery been made of the value of the "indicator," with which the recent heavy finds of gold have been associated; in fact, though being driven along under the idea that it was an "indicator," much of it was used as filling for the bottom of a shaft until the "feel" of a pick blow induced closer examination and the discovery that a lump of gold coated with ferruginous matter had been struck.

Since then gold to the value of several thousands of pounds has been nuggeted out, and it is intended to take out what was thrown down the shaft, as it is supposed to contain a quantity of gold unnoticed at the time the stuff was excavated.

The "indicator" here is simply a small but defined slate band, about 2 inches thick, of a somewhat soapy texture, usually of an olive colour, but sometimes white, grey, or nearly black, and more or less ferruginous, and likely to be pyritous at depth. The country rock is the ordinary decomposed yellowish and reddish Silurian slate and slaty sandstone.

Where small quartz veins or spurs from the country rock come in contact with the "indicator," or where bunches of quartz make along it, there, it appears, the gold is found, sometimes in large-sized pieces. In the northern of the two shafts now being worked the "indicator" simply occurs as above described, though a large surface outcrop of quartz is visible to the east on the spur. The "indicator" has been followed for about 100 feet in length at a depth of 30 feet, and a winze has followed it downwards some 16 feet without change.

In another shaft, a short distance to the south, about 45 feet deep, the "indicator" comes down between two large bodies of quartz, the lower of which is hard, solid, and described as poor, but the upper is very friable, very ferruginous, and stated to be fairly rich in gold, though not here of the nuggety character found where the "indicator" is apart from the large bodies of stone. It is also remembered now that in working the large reef outcrop further north, just where the rich alluvial ground headed from in the gully, the stone became poor where it diverged from the band now recognised as the "indicator."

The bearing of the "indicator" is a few degrees west of north and the underlay to the westward at about 55°.

A perusal of the geological map will show that approximately on this line of bearing either way from Welcome Gully for an aggregate of at least 6 miles, represented by the width of the map, there are alluvial gold workings which appear to lead from the line; and it is no more than reasonable to suppose that, if the "indicator" discovered at Welcome Gully be carefully traced, many other auriferous shoots will be found along it, possibly in close proximity to large outcrops of quartz which have been tested without success to the neglect of the less noticeable and unrecognised "indicator."

Very likely the same remarks may be found to apply to other auriferous localities in the district, such as dry diggings, &c., where careful search may reveal the existence of other "indicators."

At Rokewood Junction the alluvial workings of Paddy's Gully extend, up to a northerly and southerly line along the brow of a hill sloping westward, and more or less covered with an old wash of waterworn quartz. The workings extend some distance along the line on either side of the head of Paddy's Gully, and other patches of workings also head from this line both northward and southward. The claim wherein the discovery was made, known as Mac's Lucky claim, includes the eastern margin of the Paddy's Gully workings, and the ground is riddled with old holes.

A strong quartz lode runs along the line up to which the workings extend, and this appears to have been prospected in various places with indifferent results, but in the claim referred to it was recently found that gold was plentiful along the eastern wall under conditions that warrant the belief that an "indicator" has been discovered.

The shaft is only some 20 or 30 feet in depth, and the drive along the reef shows a narrow soft slaty band, sometimes ferruginous, sometimes soft and clayey, varying from brown or grey to nearly black in colour, in contact with the hanging wall of the reef. An inch or two of the stone in contact with the slate band is of a friable character, and in this lies the gold, in places stated to be in the form of an almost solid vein, in pieces up to several ounces in weight. The stone I saw in several parts was very rich. The rest of the reef is of the character known among miners as "buck," or stone of a hard glassy unpromising appearance.

The reef and the accompanying "indicator" have a general northerly and southerly bearing and as far as exposed are nearly vertical, the inclination being slightly to the eastward.

The two discoveries above described are so far local, though in each case there is no apparent reason why the gold should not be found to extend both longitudinally and downwards in various shoots and patches. They appear, however, to have a far wider significance than might at first be imagined, and serve as object lessons to emphasize the often repeated advice which I have given to search for the sources of the alluvial gold throughout the hundreds of miles of auriferous belts wherein the gullies and leads have been rich, but the quartz reefs proved auriferous are altogether incommensurate with them, both as regards length and richness.

The theory or working hypothesis which I feel justified in advancing is that such "indicators" as those above described are more common than people imagine, and are the proper objects of search on many of our rich alluvial gold-fields, where auriferous quartz reefs are few. It has been shown how, in the case of the Welcome Gully discovery, it would appear that richly auriferous material was being thrown down a hole until chance revealed its character; and at Rokewood Junction adjacent ground had been rooted over in all directions many years before the rich shoot now being worked was discovered.

Hitherto the attention of the quartz prospector has been principally directed to visible "blows" or outcrops of quartz and well-defined reefs, often without success; and a new departure is now to be strongly recommended in the minute search for and study of "indicators" in the vicinity of all the starting points of rich alluvial gold. There are probably many kinds of "indicators" other than those at present known. The "indicators" of Ballarat East are the most familiar, and consist of thin pyrites veins, or certain bands of slate, at the intersection of which by quartz veins rich deposits of nuggety gold are met with, and these lie along the course of the alluvial ground, which yielded so fabulously and from which so many large nuggets were won in the early fifties. The "indicators" in the localities now under notice might easily be passed in driving—especially in cross-cutting—without their character being detected, unless close observation be brought to bear on every foot driven.

Without wishing to be unduly sanguine, it may be said that great probabilities are. indicated on careful consideration of this question. Where, for instance, are the matrices of the rich alluvial deposits of Ararat, Avoca, Beaufort, and the great belts of rich nuggety ground extending from Corindhap to Haddon, and from Talbot to Wedderburn, besides many other formerly good alluvial fields? Where are the sources of the nuggets found at Dunolly alone? It is difficult to believe that the rocks and contained gold matrices were worn down to the lowest limits of their auriferous character over all these fields, and it would be certainly worth while to make vigorous search for a solution of the above questions.

In many cases the geological maps available at the Department of Mines supply close and accurate information as to physical features and proved auriferous localities over considerable areas, and, properly used, afford a bird's-eye view of the country, with suggestions—deducible from perusal of the maps—as to where the matrices of the gold should be sought for.

Maps of a less detailed character are now in course of preparation, showing the proved auriferous alluvial deposits and known reefs of several important areas, and these will also prove useful guides to the intelligent prospector.

The main thing, however, that I would wish to impress on the mining community is, as before stated, the necessity for strict search for the sources of the gold at the starting point of every auriferous alluvial deposit throughout the colony, or at places where tradition tells of marked increase of gold on the course of such deposit, or where large nuggets were found.

In conducting this search no occurrence of quartz should be neglected, but particular attention should be paid to the rock strata themselves, and anything that might possibly prove to be an "indicator" should be carefully examined, whether it be a pyrites or ironstone vein, a "pug-seam," or a band of any distinctive character.

Any such occurrences should be followed and fully tested, especially where in contact with quartz, whether in large or small bodies, flat or vertical veins or bunches, no matter how. I venture to predict that such search will not fail to bring about good results in very many localities.

REPORT ON THE GEOLOGICAL SURVEY OF DAYLESFORD GOLD-FIELD.*

(By the late Norman Taylor, Geological Surveyor.)

My original report on the geological survey of the Daylesford gold-field was forwarded to your Department in May, 1888, the plan having been sent down previously. Much of the topographical work had been left out, my instructions being, at the time, only to do gullies (in the difficult ranges of the western part of the country) which had proved auriferous, and also probable belts of reef country. Since then, however, after surveying other portions of the district to the north-west, viz., in the parishes of Campbelltown, Sandon, Strangways, and Tarrengower, I was instructed to finish filling in the Daylesford topographical work, and this is only now completed. The report above alluded to is, of course, now out of date, and has had in part to be rewritten, but much of the information therein contained has since been published in the Mining Registrar's Reports for the quarter ending 30th June, 1889, page 24, and Reports and Statistics of the Mining Department for the quarter ending 31st December, 1890, page 19. These are two articles by Mr. Mining Surveyor Mark Amos on the history of the Daylesford gold-field, and they give much of the earlier history of the field, which I was unable to obtain, and which Mr. Amos, from his long and intimate acquaintance with the district, must have had all the information obtainable in connexion therewith. In Mr. Amos' articles will be found also much information on reefs, &c., which are outside the area surveyed by me, and are consequently not alluded to in my report.

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* Geological plans and notes may be obtained at the Mining Department. Price Three Shillings.

In October, 1877, a report was published by Mr. F. M. Krausé on the progress he had made with the above survey. (See *Progress Reports of the Geological Survey of Victoria*, No. V., page 87.) The area then to be surveyed was estimated at 140 square miles, but the work was stopped in 1878, and not continued till nine years later, when the present writer was appointed to continue it. The area of the present survey is about 60 square miles, embracing portions of the parishes of Holcombe, Glenlyon, Franklin, Wombat, and Bullarook, all in the county of Talbot. Fully one-half of the area is extremely rangey, unsurveyed country, intersected by a few surveyed roads (generally following the leading spurs), the pegs and trenches of which, with few exceptions, it is now impossible to find. Mr. Krausé states in his report above mentioned that "both geologically and topographically the area presents some of the most intricate features with which he is acquainted on any of the gold-fields." He also remarks—"Owing to the natural obstacles offered in the ruggedness of the locality and the difficulty of obtaining precise and trustworthy information respecting important features uncovered by former—now abandoned—mine operations, the progress of the survey in the part completed has been necessarily slow." The western half of the district has been a great timber-producing country for the supply of the Smeaton and Creswick mines, and is so encumbered by the consequent débris that surveying by the compass and pacing is by no means a satisfactory accomplishment.

The Main or Great Dividing Range runs in a nearly east and west direction to the southward of the south boundary of the map, from whence more or less meridional spurs trend to the northwards throughout the area. From the main range issue the Deep Creek, running north-westerly, fed by streams coming in from the east; Boots' Gully and Bald Hill Creek, joining the Jim Crow Creek at Shepherd's Flat; Sailor's Creek (in its lower part called Jim Crow Creek), with Stony Creek, Spring Creek, and other eastern tributaries from the Dry Diggings-road; Sawpit and Middleton Creeks, running north; and Wallaby and Leitch's Creeks, running into the Kangaroo Creek, and trending north-easterly to the Loddon River, which, further to the north, runs westerly and picks up all the above-named streams. The lines of watershed will thus be seen to correspond generally with the strike of the country. Lava streams have issued from Eastern Hill and two hills in the Corinella paddock, flowing down the old valley of the Deep Creek; the present creek having cut its course along the extreme eastern edge of the basalt. In like manner the Bald Hill Creek valley has been filled by a flow from the Bald Hill, which joins another flow at Shepherd's Flat; and that again is joined by the Spring Creek and Elevated Plain flows; and still further north by the streams from Mount Franklin. In some instances these flows are merely represented by small selvages or terraces and table-top outliers, from 200 to 300 feet above the creeks, and the same distance below the tops of the watershed ranges. To the north-east is the the Porcupine ridge, isolated from the other flows; while to the south-east is the more extended lava stream, which has issued from many points of eruption, viz., Wombat, Fern, Snake, and other hills, and takes its course down the Loddon valley past Glenlyon, covering up and obliterating the old valley and alluvial leads now worked out, and probably numerous rich tributaries yet undeveloped. The late Mr. R. Brough Smyth, in some articles in the *Argus* of 1882–3 on the gold mines of Victoria, states that the whole of the country south of Castlemaine, drained by the Loddon and its tributaries, and extending from Glengower Creek on the west to the Coliban River on the east, was once wholly covered with basaltic lava. There is absolutely no proof whatever of this assertion. The lava, like water, has been poured out down the valleys, and has never topped the ranges, as is abundantly proved by the before-mentioned fringes of basalt resting against the steep sides of the ranges about half-way up from the creeks. Mr. Smyth bases his statement, that the whole of this enormous superincumbent mass of basalt has entirely disappeared, on the heavy denudation this particular portion of the country has undergone, owing to its rapid fall of about 91 feet per mile, and the heavy mountain rains and snows in the dividing range.

The geological formations composing this area are Lower Silurian (intersected by occasional basaltic and feldspathic dykes)—Newer Volcanic—Upper Tertiary gold drifts, and Post Pliocene.

Lower Silurian.

Mr. Krausé mentions a persistent westerly dip in these rocks between the Loddon river and Daylesford, which I have not myself noticed. The country to the east seems to be more settled, and to consist mostly of sandstone and quartzites, whilst the belt running through Wombat Hill contains all the principal reefs, is much contorted and broken, and, in depth, the rocks assume quite a metamorphic character. Numerous good examples of foldings of the strata, both anti- and synclinal, occur; and black shales containing several species of *graptolites* and *hymenocaris* are of common occurrence. The sandstones are occasionally used for rough building purposes; and slate quarries were once worked at the falls in Boots' Gully, Hard Hills, and also in the Dry Diggings Creek, but the slates were more of the nature of flags, and had not the proper slaty cleavage. This is the more peculiar, as, in general, the graptolite schists are so cleaved that it is difficult to obtain good specimens of the fossils, which lie in the bedding planes, and are cut in two diagonally by the cleavage planes. The general strike is from N. 15° to 20° W., but to the westward it becomes meridional; and still further west, on the Deep Creek, the strike is N. 5° E. A large proportion of the area of the map (the Silurian ranges) is strewn over with angular white quartz, proceeding not so much from reefs as from large and small veins reticulating the indurated sandstones, quartzites, and grits in every direction. Almost everywhere fragments of dense black conchoidal-fractured basalt may be found, far away from any lava streams. They are, probably, portions of volcanic bombs ejected from the points of eruption during the period of volcanic activity; and were mentioned years ago by Mr. Ulrich (now Professor Ulrich, of Dunedin University) as occurring on the ranges in the Franklinford district, and to the eastward. (See page 40, specimen No. 204, *Technological Museum Catalogue*, and page 23, specimen No. 1, *National Museum Catalogue.*)

Graptolites occur in the following localities:—Sailor's Creek, 5 chains below the junction of Connell's Gully, in dark blue shale (*G. fruticosus, phyllograptus folium*, and a large unnamed one figured in Professor McCoy's *Prodromus of the Palæontology of Victoria*, Decade 1, plate 1, fig. 15). Also, on the same creek, below Milkman's bridge, and in many places below that again.

Exchequer Company's shaft, and Astley Company's No. 2 shaft on the Wombat Hill lead.

One hundred feet from the mouth of the Concordia tunnel.

A quarter of a mile south of the Dry Diggings township on the west side of the road.

Argus Company's shaft, Wombat Hill.

Trafalgar Company's shaft, with *hymenocaris*, in black pyritous and aluminous slates—bedding and cleavage not coincident.

QUARTZ REEFS.

The auriferous belt before mentioned is under a mile in width, and can be traced north and south for some miles. It includes the following reefs :—Rising Star, Specimen Hill, Colliers, Freeman's or Front reef, Wombat Hill or Cornish (including the Black and Roman Eagle reefs and the Red and Mullocky lodes) Fearnot, Crown, Nuggety, Ajax, St. George, Eugenie, and Hepburn and Mauritius (Victory), nearly all of which are now abandoned. The principal feature in the lodes is that they are what are called "mullocky," *i.e.*, a network of quartz veins through slate, having generally one wall, rarely two, and sometimes none. These veins, occasionally very large, come in from a north-easterly direction, and dip to the south-west, with a certain amount of regularity. Mr. Krausé describes, in his report before mentioned, the mode of occurrence of the lode in the 520-ft. level of the Cornish Company's mine; also the Black and Roman Eagle lodes, the Mauritius (now the Freehold United) and Hepburn Reefs, and the Union Company's Reef. (*Progress Report of the Geological Survey of Victoria*, No. V., pages 89–90.)

It has been a curious feature in the Daylesford district that it has apparently rarely been able to support more than one good dividend-paying mine at a time. These have followed one another in the following succession, Cornish and Specimen Hill (both dividend-paying at the same time), Rising Star, North Cornish, and No. 1. North Cornish. The Mauritius reef, in Kidd's Gully, is said to have been the first reef opened out in 1854. The Cornish was the first to make a show, and was worked for over 32 years, followed by the Fearnot, Colliers, Argus, Mauritius, and others. The Cornish Company's mine is now the property of the North Cornish. An interesting account of the early history of the Daylesford mines may be found in the *Argus* of 29th December, 1886.

From Mr. Krausé's unpublished notes I copy the following descriptions of some of the old reefs (now abandoned), of which no particulars are now obtainable by inspection. These were written about fifteen years ago :—

*Doctor's Gully Reef** is apparently the most auriferous lode for its size in the district. From the surface to 30 feet deep it gave as much as 10oz. of gold per ton, from stone from 4 to 6 feet thick. The hanging wall is well defined, dipping westerly. At one place the flat leaders which carried the gold on the footwall were worked for a width of 50 feet; but further north these disappeared, and the gold was found on the hanging wall, which was the site of the above-mentioned large yield of gold in 1860. Some distance further south the reef is 14 feet thick, but barren.

Pitcher's Reef.†—An ill-defined lode, in places 8 feet thick, in others less than a foot thick. It is evidently a continuation of the Doctor's reef, although the connexion has not been established. A number of holes were sunk near the gully between the two reefs without finding them.

Ajax Reef.—About three chains north-west of the battery this reef is from 40 to 50 feet thick, while 100 feet further south at a depth of 160 feet it is only from 4 to 6 inches thick. It dips W. 22° S. 70°.

In addition to Mr. Krausé's notes on the Mauritius reef in the report before mentioned, I may add the following particulars. The Victory Claim has given during the dates specified the undermentioned results from a depth of from 50 to 100 feet :—

Mining Registrar's Report for—	Quartz.	Gold, per ton. oz.	dwt.	gr.	
Quarter ending 31st Dec., 1886	—371 tons, for an average of ...	0	2	2·91	at 70 feet
„ 31st March, 1887	—100 „ „ ...	0	5	20·16	

And 3 tons pyrites gave 2oz. 4dwt. 4gr. gold per ton.

„ 30th June, 1887—125 tons for an average of 20·64gr. per ton.

On the same line Messrs. Dunstan and party crushed as under :—

Mining Registrar's Report for—	Quartz.	Gold, per ton. dwt.	gr.	
Quarter ending 31st Dec., 1886	—120 tons, for an average of	1	2·85.	Surface to 40 feet
„ 30th June, 1887	—130 „ „	4	20·38.	30 to 60 feet
„ 30th Sept., 1887	— 45 „ „	1	4·80.	200 feet
„ 31st Dec., 1887	—167 „ „	5	6·07.	30 feet
„ 30th June, 1888	— 60 „ „	1	6·40.	100 feet
„ 30th Sept., 1888	— 65 „ „	1	1·74.	Shallow

This lode is said to have "faulted" an east and west dyke or "cross-course," and heaved it 30 feet *vice versâ*.

Cornish Company.—This company suspended operations in 1889, and the mine afterwards became the property of the North Cornish Company, by whom it is now being worked. A detailed plan and history of the mine by Mr. Henry Nicholas, the then manager, will be found in the Mining Registrars' Reports for the quarter ending 31st March, 1888, page 94, which leaves little to add.‡ A feldspathic dyke was passed through about 200 feet from the main shaft, and between it and the North Cornish Company's boundary. This had acted as a dam, and when cut caused a large influx of water from the workings to the north, resulting in a claim for damages. In the 862-ft. level in the new shaft there is nothing defined. At about 210 feet in the north drive large veins of quartz of varying thickness come in from the north-east and dip to the south-west—very rubbly, and full of slate with pyrites. The quartz itself is also much mineralized. The quartz and "country" exhibit peculiar contortions, and the latter is very unsettled. It is supposed that the Cornish vertical lode, which has a steeper underlie than Collier's reef, will meet the latter in depth. The mine is said to have yielded nearly 5 tons of gold since its commencement. The following are some recent crushings from the Mining Registrars' Reports:—

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* A crushing, by Merritt and party, of 25 tons gave 2dwt. 12·48gr. gold per ton, from a depth of 140 feet, in 1889.

† A crushing, by Baker and party, of 9 tons gave 3dwt. 11·55gr. per ton, from a depth of 100 feet, in 1889.

‡ See also the *Herald Daylesford Guide and Calendar for* 1891, and Reports and Statistics of the Mining Department for the quarter ending 31st December, 1890, page 21, with plans and sections, by Mark Amos.

Quarter ended.	Tons.			Gold, per ton.			
				oz.	dwt.	gr.	
31st Dec., 1886—	1,010	quartz,	averaging	0	3	8·86	from 760 feet
	47	pyrites,	„	2	9	18·63	
31st March, 1887—	386	quartz,	„	0	1	7·64	from 526 feet
	6	pyrites,	„	1	11	0	
30th June, 1887—	1,312	quartz,	„	0	4	17·93	from 520 feet
	12	pyrites,	„	2	5	20	
30th Sept., 1887—	1,720	quartz,	„	0	6	6·22	from 520 feet
	36	pyrites,	„	2	18	21·30	
31st Dec., 1887—	1,780	quartz,	„	0	3	11·20	from 520 feet
	32	pyrites,	„	3	6	21	
31st March, 1888—	3,460	quartz,	„	0	2	13·07	from 420 feet
	63	pyrites,	„	2	10	18·66	
30th June, 1888—	1,402	quartz,	„	0	1	20·42	from 420 feet
	30	pyrites,	„	2	14	6·40	
30th Sept., 1888—	405	quartz,	„	0	1	8	from 420 feet
	30	pyrites,	„	2	13	8	
31st Dec., 1888—	785	quartz,	„	0	3	14·36	from 621 feet
	10	pyrites,	„	5	0	0	
31st March, 1889—	2,000	quartz,	„	0	1	8·61	from 621 feet
	27	pyrites,	„	2	0	0	
30th June, 1889—	2,500	quartz,	„	0	1	11·91	from 621 to 964 feet
	36	pyrites,	„	2	1	9·33	
30th Sept. 1889—	1,364	quartz,	„	0	2	21·14	from 500 to 600 feet
	23	pyrites,	„	1	16	0	
31st Dec., 1889—	999	quartz,	„	0	1	0	shallow
31st March, 1890—	251	„	„	0	2	0	shallow

North Cornish Company.—This company have sunk their main shaft (No. 1) to a depth of 780 feet, with the following levels:—No. 1 at 310 feet, No. 2 at 362 feet, No. 3 at 420 feet, No. 4 at 490 feet, No. 5 at 560 feet, No. 6 at 630 feet, No. 7 at 702 feet, and No. 8 at 770 feet In No. 1 level the reef was struck 120 feet east of the shaft. It is about 8 feet thick, and is driven on north 227 feet. In No. 2 level the reef was reached at 92 feet east of the shaft, 5 feet thick, and was driven on north 300 feet. From this level 80 tons of quartz yielded 86oz. 16dwt. of gold, and a total of 1,292 tons gave 589oz. 15dwt. The water was heavy at about 370 feet from the surface. In No. 3 level the reef was struck at 60 feet east of the shaft, about 15 feet thick, and is driven on north 454 feet, and connected by a winze there with No 4 level. In No. 4 level the reef was met with at a short distance from the shaft, and driven on 510 feet with, in places, 22 feet of crushing stuff. The first 100 feet was in payable stone, but latterly much broken. In No. 5 level the reef was struck 32 feet west of the shaft, which it passed through between these levels. It is driven on north 542 feet and south 88 feet, in the former to 375 feet along payable reef 7 feet thick, but afterwards broken. There are three rises to No. 4. In No. 6 level the reef was struck at 75 feet, 12 feet thick. It is driven on north 110 feet, where the reef was 4 feet thick, and south 55 feet, in broken country. A little stoping has been done in No. 5, but mostly from No. 4 upwards. In No. 4 level the dip or underlay of the reef is W. 35° S. 54°. It has a good even footwall, with black clay casing, but no hanging wall. It is from 7 to 8 feet thick, well laminated, and full of pyrites, with occasional zinc blende (black jack) and galena (lead sulphide). The quartz is said to average from 8¾dwt. to 9½dwt. gold per ton, and the pyrites about 4½oz. gold per ton. The following yields are from the Mining Registrars' Reports:—

Quarter ended.	Tons.			Gold, per ton.			
				oz.	dwt.	gr.	
31st Dec., 1886—	3,860	quartz,	averaging	0	8	21·94	from 490 feet
	42	pyrites,	„	4	11	9·71	
31st March, 1887—	3,866	quartz,	„	0	9	9·42	
	22	pyrites,	„	4	12	19·63	
30th June, 1887—	5,120	quartz,	„	0	7	7·11	from 490 feet
	8	pyrites,	„	7	2	15	
30th Sept., 1887—	4,860	quartz,	„	0	7	16·49	from 490 to 560 feet
	39	pyrites,	„	5	4	3·07	
31st Dec., 1887—	5,545	quartz,	„	0	8	7·47	from 490 to 560 feet
	123	pyrites,	„	4	2	21·26	
31st March, 1888—	4,730	quartz,	„	0	8	19·35	from 560 to 630 feet
	79	pyrites,	„	4	14	6·68	
30th June, 1888—	4,630	quartz,	„	0	5	15·76	from 560 to 630 feet
	129	pyrites,	„	5	3	9·48	
30th Sept., 1888—	7,160	quartz,	„	0	5	13·67	from 560 to 630 feet
	63	pyrites,	„	5	1	7·61	
31st Dec., 1888—	6,215	quartz,	„	0	5	20·8	from 560 to 630 feet
	113	pyrites,	„	5	16	4·46	
31st March, 1889—	6,155	quartz,	„	0	6	10·04	from 560 to 630 feet
	103	pyrites,	„	6	9	3·02	
30th June, 1889—	5,390	quartz,	„	0	5	18·34	from 560 to 630 feet
	104	pyrites,	„	6	2	4·38	
30th Sept., 1889—	6,595	quartz,	„	0	5	6·67	from 560 to 700 feet
	89	pyrites,	„	4	9	1·88	

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st Dec., 1889	—5,785 quartz,	averaging	0	7	19·84	from 560 to 700 feet
	225 pyrites,	„	4	16	4·46	
31st March, 1890	—4,885 quartz,	„	0	5	13	from 630 to 700 feet
	134 pyrites,	„	5	12	9	
30th June, 1890	—6,775 quartz,	„	0	4	18	from 630 to 700 feet
	157 pyrites,	„	4	8	0	
30th Sept., 1890	—7,915 quartz,	„	0	7	0	from 410 to 700 feet
	136 pyrites,	„	5	11	3	
31st Dec., 1890	—6,720 quartz,	„	0	7	0	from 410 to 700 feet
	133 pyrites,	„	5	9	20	
31st March, 1891	—6,314 quartz,	„	0	4	18	from 410 to 700 feet
	98 pyrites,	„	6	8	23	
30th June, 1891	—6,495 quartz,	„	0	4	12	from 410 to 770 feet
	234 pyrites,	„	3	9	13	
30th Sept., 1891	—7,490 quartz,	„	0	5	4	from 410 to 770 feet
	143 pyrites,	„	3	13	9	

The total yields from this mine from its commencement to 31st December, 1891, are as under, and were kindly supplied by the legal manager, Mr. J. Smidt, J.P.:—

	£	s.	d.
Gold from battery, 43,571oz. 10dwt., from 137,515 tons quartz, value ...	175,080	13	11
Gold from pyrites, 11,079oz. 7dwt., from 1,952½ tons quartz, value ...	44,040	2	7
From tributes	560	17	7
Dividends have been paid, amounting to	100,500	0	0
Wages	65,878	8	11

The foregoing was written at the close of 1887, since which time much work has been done in the mine. Nos. 4, 5, 6, 7, and 8 levels have been extended north to the No. 1 North Cornish boundary. No. 6 is connected with the Cornish main shaft to the south (560 feet). No. 7 is connected with the Fearnot shaft to the north (480 feet). No. 4 is driven south 211 feet along a rather broken reef, with patches of payable stone. In the No. 7 level an eastern reef was struck 38 feet west of the shaft, and 8 feet thick, and the main reef 77 feet beyond that. In the No. 8 level the eastern reef was cut at 80 feet, from 2 to 6 feet thick, and driven on south for 90 feet showing gold. The main reef was struck at 140 feet west of the shaft, and driven on north 12 feet.

The company have now, since the purchase of the Cornish lease, four shafts working—No. 1, or the main shaft; No. 2, the old Fearnot shaft, cleaned out, timbered, and plant erected at the end of 1888; No. 3, The Cornish main shaft; and No. 4, on Collier's reef. This latter is opened out at 280 feet to drive for Collier's reef. No. 2 is down 780 feet, and No. 3 is working at the 760-ft. level on as payable stone as the North Cornish have had, although unpayable to the former company. The success of this mine is attributable to the splendid gold-saving appliances and plant and the careful management. In 1888, the Frue Ore Concentrators or Vanners, for saving the pyrites, were introduced, and in the same year the Pyrites works, using the Newbery-Vautin Chlorination process, were started, and have been a great success. From Mr. John Freeman, the mining manager of the company, I have obtained the following information:—No. 2 shaft (Fearnot)—The 770-ft. level is driven south for 340 feet through a large reef showing gold, and a rise has been put up to the 700-ft. level. At 280 feet from the cross-cut another rise to the 700-ft. level passed through a large body of quartz showing gold. Stoping is being carried on in both Nos. 1 and 2 shafts, chiefly between the 560 and 700 feet levels. Very little has been done in the lower levels on account of the large blocks still standing in the higher levels. No. 3 (Cornish)—At the 760-ft. level a drive was carried north on the eastern reef for 70 feet, in a large body of quartz, which has proved payable. No. 4 (Collier's)—This was formerly worked with good results to a depth of 240 feet. The shaft has been repaired, and sunk a further depth of 40 feet, and a winding plant erected.

No. 1 North Cornish.—This company's shaft is sunk to a depth of 840 feet, cutting the reef at 470 feet, and the supposed cap of the Fearnot reef about 30 feet from the surface. There are levels as follow:—No. 1 at 250 feet from surface, No. 2 at 320 feet, No. 3 at 400 feet, No. 4 at 490 feet, No. 5 at 560 feet, No. 6 at 630 feet, No. 7 at 700 feet, No. 8 at 770 feet, and No. 9 at 840 feet. Little has been done in No. 1 level. In No. 2, a flat reef was met with, from which 219 tons of stone gave 108oz. 15dwt. of gold. At the 560-ft. (No. 5) level the reef, from 2½ to 3 feet thick, was struck west (W. 8° S.) of the shaft about 50 or 60 feet. It underlays generally about W. 15° S. at an angle of 59° across the "country," which underlays E. 15° N. 77°, but at the No. 4 level, the country is said to dip both ways. It has been driven on to the North Cornish workings south, and for some distance north. At 55 feet in the north drive in the 560-ft. level what appears to be a "horse" came in, and another make of quartz occurred behind the footwall with its black clay casing. A hard bar of sandstone was met with near the shaft in the westerly cross-cut; and a short but good horizontal leader joined the reef from the east on its footwall. Eighty-five tons quartz from this level gave 20oz. of gold, and 138 tons, 29oz. of gold. The general direction of the reef is N. 15° W., but it is a little wavy. In the 630-ft. level (No. 6) the reef was cut 3 feet thick at 97 feet west of the shaft, and the drive was extended to and across the supposed "track" of the Fearnot reef about 240 feet. At the 400-ft. level (No. 3) a cross-cut was driven west to cut the Fearnot without success. It appears that there was no regular reef above the 560-ft. level, but all was broken up. The reef is much intersected with carbonaceous clay, and quartz veins, and angular pieces of slate, and contains pyrites, zinc blende, and galena sparingly. It is partly laminated, and has a carbonaceous black clay casing or selvage on the footwall. On what should be the hanging wall is a gneissose-looking schist with nearly horizontal quartz veins dipping south. To the east the "country" appears more settled. In the 700-ft. level there is a mineral spring, of the same character as the Hepburn spring, which causes considerable annoyance to the miners, and other measures have to be resorted to, besides the powerful Root's blowers, to get rid of the carbonic acid gas. In this level the reef was struck at 170 feet. A small down-throw occurred in this level, too small (1 inch) to be noticed in the levels above and below it. The dip at the break was E. 20° N. 70°. The reef is driven along north and south. In the south drive there is a peculiar sort of arch between the walls, like the cap of a saddle reef, with horizontal veins of quartz above it. In the north drive the reef was 2 feet thick and well defined. In the 770-ft. level (No. 8) the reef was struck at 210 feet west of the shaft, and in the 840-ft. level (No. 9) at 245ft. 6in. west. In this last level, at 16 feet west of the shaft, a new reef was passed through showing gold. It was cut in the shaft at about 800 feet. All the lower levels above this are through to the Fearnot shaft workings and the North Cornish, and from thence to the Cornish. Slides from the west are a feature in this mine.

The following are results of crushings taken from the Mining Registrars' Reports:—

Quater ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st Dec., 1886—	219 quartz,	averaging	0	9	22	from 320 feet
31st Dec., 1887—	85 „	„	0	4	16·94	„ 560 „
31st March, 1888—	753 „	„	0	4	2·83	„ „ „
30th June, 1888—	1,016 „	„	0	5	1·86	„ 560 to 630 feet
30th Sept., 1888—	Sinking.					
31st Dec., 1888—	600 quartz,	averaging	0	8	11·40	from 630 feet
	23 pyrites,	„	4	17	5·21	
31st March, 1889—	1,208 quartz,	„	0	7	12·17	from 630 to 700 feet
	31 pyrites,	„	5	8	5·41	
30th June, 1889—	1,570 quartz,	„	0	2	12·49	from 630 to 700 feet
	23 pyrites,	„	3	4	2·08	
30th Sept., 1889—	3,320 quartz,	„	0	3	6·48	from 630 to 700 feet
	82 pyrites,	„	2	7	2·04	
31st Dec., 1889—	2,840 quartz,	„	0	5	18·34	from 700 to 770 feet
	80 pyrites,	„	2	18	16·25	
31st March, 1890—	2,730 quartz,	„	0	6	19	from 630 to 770 feet
	73 pyrites,	„	3	16	8	
30th June, 1890—	2,610 quartz,	„	0	5	9	from 630 to 770 feet
	40 pyrites,	„	4	0	22	
30th Sept., 1890—	3,520 quartz,	„	0	3	9	from 630 to 770 feet
	118 pyrites,	„	2	8	22	
31st Dec., 1890—	1,270 quartz,	„	0	4	18	from 630 to 770 feet
	37 pyrites,	„	2	14	1	
31st March, 1891—	1,079 quartz,	„	0	6	13	from 630 to 770 feet
30th June, 1891—	1,109 „	„	0	6	13	„ 560 „ „
	34 pyrites,	„	3	3	1	
30th Sept., 1891—	655 quartz,	„	0	4	1	from 560 to 770 feet
	29 pyrites,	„	2	8	14	

The company has paid some small dividends, but has unfortunately been unable to continue them; although I think that brighter prospects are in store for it.

The Great Cornish Company commenced to sink for the Cornish lode at the end of the year 1886, but stopped sinking at a depth of between 80 and 90 feet.

The Cornish and York put up their machinery in 1887, cleared out the old shaft, and started to look for the Crown reef at 380 feet, that was said to be so rich to the water level. The water was heavy, and the gas from the old workings troublesome. An old cross-cut was passed through at 195 feet. The company suspended operations in September, 1889, but afterwards worked on intermittently by aid of Prospecting votes. It is now abandoned and the plant removed.

Samson's Reef, half a mile to the east of the Crown claim, was raising stone in 1882–3, yielding as high as 1 ounce per ton. This reef is on the Eureka line.

The Freehold United started at the end of 1886, and are working several claims on the Mauritius line of reef, which were in past years—between 1869 and 1873—very rich to the water level. They have sunk 320 feet, and at the 310-ft. level have driven north 187 feet along the course of the lode, with quartz on the footwall, but not payable. It is cross-cut to the east for 182 feet, through sandstones and shales with quartz leaders, some showing a little gold. The lode in No. 2 north drive is heavily mineralized, and was worked to great advantage to the water level. A very hard bar was passed through in the last 180 feet to 190 feet from the bottom of the shaft, with slates to the east and west of it. There are said to be four distinct reefs on the property as well as several flat shoots. The company suspended operations for some time in the beginning of 1891, but are now at work again. Several feldspathic dykes occur in the property—one running E. 10° N. (and dipping north) across the "country," with a steep easterly dip. The reef on the main line dips to the west at an angle of 35 degrees, but the angle is very variable between this and 60 degrees. Further east an eastern leg apparently dips to the east with the "country." It appears that a large lode has lately been struck, yielding 6dwt. per ton. To quote from the *Argus* of 2nd January, 1892:—"An interesting experiment is also being carried on in connexion with this mine, namely, the treatment of pyrites without calcination, by the cyanide of potassium process (the McArthur-Forrest process). The works have been erected, and preliminary operations are being carried on under the supervision of Mr. McIntyre, who was sent out from Scotland by the patentees of the process." The mine has been worked in various parts on tribute, and the following are some of the results of crushings, from the Mining Registrars' Reports:—

	Quarter ended.	Quartz.			Gold, per ton.		
					dwt.	gr.	
Betheras and party,	31st March, 1887—	101	tons,	averaging	5	5·46	from 40 feet
Jones and party	... ...	17	„	„	6	3·76	„ shallow
„	30th September, 1887—	228	„	„	4	7·36	„ 50 to 100 feet
„	31st December, 1887—	55	„	„	6	0·50	„ 40 to 80 feet
„	30th June, 1888—	96	„	„	8	18·50	„ 100 to 120 feet
Dunstan and party,	30th September, 1888	65	„	„	1	1·74	„ shallow
„	30th June, 1889—	173	„	„	3	3·26	„ 50 to 200 feet
„	31st December, 1889—	343	„	„	3	12·06	„ various depths
„	31st March, 1890—	279	„	„	4	1	„ 30 to 100 feet
„	30th June, 1890—	141	„	„	1	23	„ 40 feet

Trafalgar Company.—The reef worked by this company is on the Nuggety or Ajax line, and has been sunk on 180 feet and driven west to cut the 2-ft. reef passed through at 120 feet, which carried gold and good walls. It was cut at 23 feet from the shaft and driving south commenced, but the works are now stopped. They have a battery and dam purchased from the Ajax Company. In the quarter ending 31st December, 1886, they crushed 84 tons for an average of 12dwt. 18·97gr. gold per ton, from a depth of 50 feet. The reefs formerly worked in this neighbourhood are probably on the Star line.

Magazine Reef is being worked by Young and party with the following results:—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st March, 1889—	12 quartz,	averaging	0	8	21·50	shallow
30th Sept., 1889—	13 „	„	0	11	23·07	from 40 feet
31st Dec., 1889—	13 „	„	0	11	19·38	„ 50 „
30th June, 1890—	15 „	„	2	12	8	„ 75 „
30th Sept., 1890—	13 „	„	1	2	20	„ 35 „
30th June, 1891—	42 „	„	0	13	8	„ 100 „

Commissioner's Reef.—This reef was at one time exceedingly rich. It is a vertical irregular lode, and very wet. The Golden Spring Company are now working on this lode. Their shaft was 269 feet deep (57 feet below plat). The bottom level at 212 feet is driven 430 feet in a direction of 165½° but turns. The footwall is good, but the reef is very irregular in underlay and undulates in strike. The "country" is chiefly sandstone. At the 140-ft. level the reef is 18 inches thick and broken. The north drive is in 611 feet in tight slate. A rise of 48 feet broke through to the north old shaft, reef 15 inches thick. At 376 feet "indicator" slates make their appearance. From reports and statistics of the Mining Department I extract the following crushing result:—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st March, 1890—	21 quartz,	averaging	0	3	13	from 220 feet
31st Dec., 1890—	760 „	„	0	12	16	„ 140 to 212 feet
31st March, 1891—	810 „	„	0	5	10	„ „ „ „
	19 pyrites,	„	3	13	16	
30th June, 1891—	798 quartz,	„	0	3	7	from 140 to 212 feet
30th Sept., 1891—	1,093 „	„	0	6	7	„ 287 feet
	21 pyrites,	„	2	16	0	

On the Try Again line, Kidd's Gully, the Florence, New Florence, and Morning Light have been worked, the former having only recently been wound up. The Try Again reef, worked by Richardson and party, has given the following results:—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st March, 1891—	14 quartz,	averaging	0	0	5·1	from 50 feet
30th June, 1891—	20 „	„	0	6	5	„ „
30th Sept., 1891—	37 „	„	0	9	3	„ „

The Wonderful Reef was started again in the middle of 1889. They sunk 130 feet, and opened out at 113 feet, and crushed—

30th Sept., 1891—18 tons quartz, averaging 10dwt. 6gr. gold per ton, shallow.

Baker and Krœger (Pitcher's Reef) working on the northern extension of the Cornish reef, Doctor's Gully, struck a reef at 96 feet, 4 feet thick—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
30th June, 1889—	9 quartz,	averaging	0	3	11·55	from 100 feet
31st Dec., 1889—	84 „	„	0	17	2·85	
30th June, 1890—	86 „	„	0	11	5	from 100 feet
31st Dec., 1890—	130 „	„	0	7	3	„ 130 „
31st March, 1891—	98 „	„	0	11	5	„ „ „

The Bismarck Reef, Hepburn, worked by Hines and party, crushed—

31st March, 1890—20 tons quartz, averaging 12dwt. 12gr. gold per ton, from 100 feet.

All the lines of reef appear to split and open out like a fan as they go northward.

Of the following reefs I have no record:—Eureka, Princess Alexandra, St. George, Eugenie, Anchor Company, Perrin's, West End, Italian Gully, Warrior, and many others hardly remembered by name even now.

To the east of the above belt of reefs lie those passing through the Dry Diggings—the Beehive, Sportsman, and others.

Jackson and Kirkham's *Middleton Creek Reef*—later, the *Ellesmere*, but now abandoned—has given the following results. In the last week of May, 1886, 16 tons quartz yielded an average of 1oz. 15dwt. gold per ton:—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st December, 1886—	67 quartz,	averaging	0	12	16·11	from 20 feet
31st March, 1887—	72 „	„	0	5	9·66	„ 65 „
30th June, 1887—	80 „	„	0	5	22·50	„ 70 „
30th September, 1887—	230 „	„	0	5	6·36	„ 80 „
31st December, 1887—	38 „	„	0	9	17·68	„ 100 „

Strack's Beehive Reef, Dry Diggings, is about 1 foot thick, and dips easterly across the westerly underlay of the country, with horizontal leaders coming in on the footwall. To the south of the dam what appears to be the cap of a saddle reef is exposed. The following are the latest yields:—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
31st March, 1887—	30 quartz,	averaging	0	3	8	from 40 feet
30th June, 1887—	34 „	„	0	11	1·41	„ 10 „
30th September, 1887—	49 „	„	0	12	18	„ 70 „
31st December, 1887—	146 „	„	0	3	5·46	„ 40 „

Shimmin's Reef and the *Sir John Franklin* are situated on the watershed to the leads passing through the Shakespeare Company's ground. They have not long been opened. Thirty-three tons from this small reef gave an average of 1oz. 1dwt. 13·81gr. gold per ton, at 40 feet in depth :—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
30th June, 1888	15	quartz, averaging	0	8	0	from 40 feet
Sir John Franklin—						
30th June, 1888	20	„ „	0	5	0	„ 40 „
Trembath and party—						
30th June, 1888	21	„ „	0	2	9·14	„ 50 „
Black Swan—						
30th June, 1890	23	„ „	0	8	9	„ 45 „

It would appear that the St. George's reef, lying to the east of the Crown reef, is the southerly extension of the Mauritius and Hepburn reefs and those in the Freehold ground; and that this reef, in its still further southerly extension, will pass under Wombat Hill, and has been the source of supply of the Wombat Hill lead, while the Crown reef has supplied the Township lead. The reefs to the northward are said to be much faulted by dykes or cross-courses, one of which, occurring in the Crown claim at the head of Kidd's Gully, is said to have heaved the reef 70 feet to the west.

From the underlay of the strata at Dry Diggings being to the west, whilst the reefs dip east—the exact reverse of what obtains in the Cornish belt of reefs—it is possible that they may be a recurrence to the surface of the same reefs on both sides of a large synclinal trough.

Westward of all the above lines of reef is another, which has followed the valley of the Sailors' Creek, and on which were situated the Murray Company, the Glaston, and the National. They are all now abandoned. The first is the only one that has been recently worked. There are said to be two lodes in the mine, viz., the Cosmopolitan, a vertical one; and the Murray, a flat shoot, with walls about 60 feet apart. The shaft is 120 feet deep, and the reef was cut off by a slide at 50 feet. There was much trouble with carbonic acid gas, probably derived from the mineral spring at Tipperary Point.

Westward again is the line of the Adelaide reef, also now abandoned. Its extension to the north has been largely prospected by White and party. A crushing gave—

	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
30th June, 1887	22	quartz, averaging	1	13	15·27	from 50 feet

Further westward again is the Keep-it-dark line of reef, on which were situated the South Keep-it-Dark Company, Keep-it-dark Company, Walker's Last Chance, and the Alabama.

The South Keep-it-dark Company sunk their shaft 345 feet—the deepest on the line. At 340 feet they drove west 22 feet, but met with very heavy water. The reef cap was struck at 338 feet, dipping in strike to the south. It underlays east at about an angle of 45°. The quartz is finely laminated, and dark coloured, about 1¼ inches thick, with about a foot of black carbonaceous clay casing on the hanging wall. It makes into bunches 6 inches thick, and contains pyrites.

Keep-it-dark Company (late Iveson's).—The shaft at 200 feet is driven easterly 210 feet, and struck payable gold. It is stated that at one time over 100oz. gold was obtained from a bucket of stone. A crushing gave—

Quarter ended.	Tons.		Gold, per ton.			
			oz.	dwt.	gr.	
30th September, 1887	31	quartz, averaging	0	4	0·87	from 200 feet
31st December, 1887	40	„ „	0	6	12	„ „

Walker's Last Chance lies to the north of the above, and has been extraordinarily rich in former times. They carried down rich stone with them for 40 feet. The first crushing in 1872 of 16 tons gave a return of 235oz. gold; the second, of 12 tons, of 321oz. gold, since which there is no record. Other claims (Salmon's and Pitt's) to the north yielded from 8 to 10oz. to the ton, the stone being 5 feet wide. There are two parallel reefs, the bearings of which are said to be from N. 8¼° to 8¾° E., but I imagine these bearings were made to fit the leases they were wanted to run through, as the reef now runs slightly to the west of north. With very little searching gold in quartz may be picked up on the surface along the line of reef further north, and the whole line is deserving of more attention than it has hitherto met with.

The Keep-it-dark line of reef has undoubtedly been the main source of supply of all the alluvial leads heading from it on its east and west sides. It may be traced on the plan—with only slight deviations from its course, due probably to difference of level or faults—to the Criterion and Golconda reefs, near the north boundary of the sheet; and the reef met with in the old Corinella Company's alluvial workings, recently worked under the Mining on Private Property Act, is, no doubt, its southerly extension, and was probably the great supplying medium of that wonderfully rich paddock, which is said to have produced in twenty years over 2½ tons of gold.

The Golconda Reef is situated at German Gully, just outside the north-west boundary of the map. It has levels at 200, 330, and 430 feet; underlays west at 1 in 6, but is often vertical. At 330 feet its thickness was 40 feet; and at 430 feet, 28 feet. What appears to be a saddle occurs in the bottom level. Another reef, formerly worked as "Goldsmith's" by a tunnel, lies 200 feet to the west; and another occurs 100 feet further west, accompanied by a "lava streak." In the tunnel the dip of the "country" is easterly. The quartz is very highly mineralized, chiefly with ordinary pyrites and smaller quantities of zincblende and galena. The Golconda Company are also the proprietors of the Criterion reef to the south, which was very rich in 1882, but no work has yet been done on it. The following are some recent crushings :—

Quarter ended.	Tons.		Gold per ton.			
			oz.	dwt.	gr.	
31st March, 1890	155	quartz, averaging	0	10	17	from 430 feet
30th June, 1890	390	„ „	0	3	2	„ 330 to 430 feet
30th September, 1890	168	„ „	0	5	22	„ 430 feet
31st December, 1890	203	„ „	0	9	20	„ 330 to 430 feet
31st March, 1891	119	„ „	0	6	19	„ „
30th June, 1891	122	„ „	0	2	10	„ „

The Rising Star, on the line of the Frenchman's Reef at Blind Creek, lies some distance south of and outside the boundary of the present plan. It is the southern extension of the Ajax and Nuggety line. Full particulars, with plan and sections, will be found in Mr. Mark Amos' report before mentioned.

Togni's Mundic Reef.—Near the Basalt Hill school-house, in a tunnel for the lead underlying the basalt, a promising-looking though small reef was discovered, striking N. 10° W., with a nearly vertical west dip. On the east are slates, and on the west soft sandstones. It has good walls and a carbonaceous clay casing, but the mundic is scarce. Assays not coming up to expectations, it was abandoned.

NEWER VOLCANIC.

The points of eruption within the area of the map from which the various lava flows about Daylesford have emanated are Wombat Hill—an unnamed hill to the west of the Hon. W. E. Stanbridge's "Wombat Park" estate; Fern Hill, Snake Hill, Bald Hill, Elevated Plain, Porcupine, Mount Franklin—a hill in Egan's Corinella P.R., and Eastern Hill. Several others outside the boundary of the map have also contributed their quota. There have been two distinct flows about Daylesford itself, probably following one another at no great interval of time. Mr. Krausé states—"The older flow emanated from one or more points north of Wombat Hill; the latter and less widespread flow came from Wombat Hill itself, and its border is well defined along a contour some 140 feet below the crown of the hill. A thick deposit of ash and scoriæ, with grains of obsidian, fills a great part of the depression between Wombat Hill and Fern Hill" —(*Prog. Rep. Geol. Survey of Victoria*, No. 5, page 90). The lava of the points of eruption presents the usual characteristics, being scoriaceous and vesicular, and containing much olivine, hyalite (volcanic glass), hornblende and oligoclase (glassy feldspar). It has occasionally also a distinctly fluidal structure, as if suddenly cooled and hardened while in a viscous state. Away from its sources the basalt becomes denser, and rarely contains any observable minerals, except crusts of carbonate of lime in the vesicles. It is occasionally slightly magnetic, and in some places there is a great deal of local attraction. For a very remarkable instance, which it is not easy to account for, see Plan note 23.

Mount Franklin (Larne Barramul), 2,092 feet above sea level, stands pre-eminent as one of the most conspicuous and, at the same time, one of the most distinctly-marked craters that we have in the central part of the colony. Mr. (now Professor) Ulrich's description, on quarter-sheet of the *Geological Survey of Victoria*, 15. S.E., note 1, is worthy of repetition, as the map is, I believe, out of print:—"The rather narrow margin of this crater, for a good distance down the outside and inside slopes consists of a mixture of earthy scoriaceous basalt and real pumice-like scoriæ—the former containing pieces of white transparent 'oligoclase,' and irregular lumps, frequently above several pounds in weight, of 'olivine,' which latter, through part decomposition has, however, lost its green colour, presenting either a uniform brownish red or brown, speckled with green, appearance. The bottom of the crater, lying about 250 feet below the highest point of the rim, has an area of several acres,* and shows two very gentle rises of unequal size, divided by a narrow depression. As the whole of this area lies lower than the bottom of the rent in the rim of the crater (through which, apparently, the latest lava stream issued), it is probable that its own and the drainage down the inside walls of the latter, having no direct outflow, soaks off through the porous basalt of the mantle, and contributes largely to the numerous springs around the foot of the mount. Near the centre of this bottom area a shaft has been sunk some 40 feet in a bluish-grey, very hard and dense basalt, in which large nodular masses of bright green 'olivine' and smaller ones of transparent 'oligoclase' are very abundant; it also contains, though more sparingly, small irregular crystalline pieces of black 'hornblende.'" On the north face of the external slope of the crater is a gorge, of which Mr. Ulrich speaks as follows:—"A narrow very precipitous rent in the side of the crater exposes at this place thick variously-coloured beds, of volcanic ash, and cinders and scoriæ-conglomerate, which dip at an angle of 17° towards the centre of the mount. It remains doubtful whether this ravine actually owes its origin to a side outbreak of basaltic lava—the source, perhaps, of the basaltic stream in the flat below—or whether it has simply been caused by strong flows of water from the top of the mount." In a further note he says:—"The basaltic lava streams of the country comprised in this quarter-sheet are of two different ages. The older is antecedent to and has been denuded during the formation of the present main drainage channels, and now forms detached patches, capping isolated hills or long narrow stretches on the tops of ranges. The more recent streams have poured into the present valley, and, in their gradual descent from high points of eruption, appear in some cases to have covered the Post-pliocene as well as the older and newer Pliocene drifts—Jim Crow Creek and Mount Franklin streams. Only where they have acted as natural bars to, or lie in the line of, the drainage from higher levels they are in their turn covered by recent alluvium—patch near Yandoit Swamp, Franklinford, &c. As regards lithological character the two flows present no marked difference; and where the one overlaps or comes in contact with the other the boundary, as on the Mount Franklin flanks, can only be indicated approximately."

The old (now destroyed) trigonometrical station is about 300 feet above the bottom of the crater, and the lip of the rent is 12 feet above it. The highest point is 72 feet above the Daylesford railway station (2,020·18 feet), and about 380 feet above Dry Diggings.

I have elsewhere alluded to the occurrence of fragments and chips of a dense-black conchoidal fractured basalt, which is to be found scattered over the ranges far and wide, and at considerable distances from any possible source. The only rock approaching it in character lithologically is one occurring to the south-west of Kyneton, in the parish of Tylden, and on the east bank of the Coliban River (quarter-sheet *Geological Survey of Victoria*, 9. S.E.) It is described in the *National Museum Catalogue*, page 23, No. 1, as a rock having the appearance of Lydian stone. It sometimes contains minute grains of olivine.

Mr. Krausé, in the report before mentioned, describes the mode of occurrence of the pipe and crater of an old volcano discovered by the alluvial workings north of Wombat Hill, and also a somewhat similar occurrence at Wombat Hill itself. The Wombat Hill Company's No. 1 shaft, at the back of the Presbyterian Church, was sunk through—

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* I find the area of the nearly true circle forming the crater bottom to be 5¼ acres.

Basaltic soil	10 feet
Basalt	80 „
Silurian strata	40 „
	130 feet

They drove 390 feet east, and struck a wall of basalt running south-east; they then sunk 170 feet against it without bottoming; came back again, and drove through the basalt wall, which was 50 feet thick (some say 70 feet), and came on the gutter on the other side. I have been informed that where the lead was again found great piles of good washdirt were heaped, as it were, up against the rock, as if the outburst of the basalt had pushed the gutter wash to one side. My informant endeavoured to show a connexion between this dyke and the pipe above mentioned, which I do not think has either been proved or exists. He makes the dyke to run 10° west of north, and that it wedges out to a mere crack in the Dannebrog Company's shaft to the east. Others say it was cut in the Union Company's workings at the intersection of Victoria and Orford streets—under the intersection, or near it, of Victoria and Daly streets. The question remains to be solved in the future by any reef workings which may be extended under Wombat Hill. Another similar occurrence at the Elevated Plain is thus described by Mr. McLeish, an old miner and resident:—"In the year 1857 a party of Italians put a tunnel into the north end of the Elevated Plain, with the object of striking an alluvial lead of gold supposed to lie some 180 feet below the top of the plain. The tunnel was put in 1,200 feet, when it was found necessary to rise about 25 feet to get at the level required. The party were successful in getting the gutter looked for, and which was the means of sending nearly all the shareholders, six in number, to their native country with a 'pile.' After they had opened out the gutter and driven on its course for several hundred feet it was found that the lead of gold was suddenly interrupted by a basaltic wall, which rose perpendicularly from a bed of soft-slate reef. Gold in good payable quantities was got right up to this interruption. A drive was put in to both right and left of what the party thought at first to be a very large basaltic boulder. No indication of wash was found, and a small shaft was sunk some 12 feet in depth alongside of this supposed boulder. 'Colours' of gold were got all the way down, with no sign of a change in the basaltic wall, which was perpendicular. In the meantime drives were carried on in different directions till the wash of the 'lead' was discovered some 70 feet away from the wall first met with, and exactly at the level the gutter should be found at. Further examination of the basaltic break disclosed the fact that it was neither more nor less than a true basaltic pipe of an oval or circular form."

Basaltic dykes are of frequent occurrence, and there may be many in the old reef workings that I am not aware of. The following are some of the localities:—Kidd's Gully, Spring's-road (two), Victory Tunnel (Mauritius reef), road cutting near Hepburn State School (see sketch), North Cornish and Front or Freeman's reef, Wombat Hill, Ballarat-road west of Sailors' Creek-bridge (see sketch), and Italian Gully, Boots'. There are also a number of dykes or cross-courses in the Freehold United mine, but owing to their being generally much decomposed—in fact, clays—it is difficult to distinguish between the basaltic and feldspathic dykes.

At Upper Blanket Flat the old Extended Company sunk shafts for, it is said, about 300 feet, without bottoming, in a conglomerated mixture of volcanic ash and black basalt. There is no sign of basalt on the surface or in the gully and surrounding alluvial workings; and the whole occurrence, together with others in the Corinella Paddock and on the Deep Creek, must, owing to the length of time which has elapsed since the workings were carried on and the vagueness of the information obtainable, be an unsolved problem till further developments take place. I have had it on good authority that infusorial earth was found in these shafts, which would give the locality a lacustrine aspect.

The Alluvial Leads.

It is said that the first alluvial gold was discovered at Golden Point, Hepburn, in 1851. The first rush to Jim Crow (as Daylesford was then called) took place about the year 1853, the principal workings being Connell's Gully, Sailors' Creek, Wombat Flat, the old Race-course, and Doctor's Gully—all alluvial. A second rush took place in 1855, but the heaviness of the timber, dense undergrowth of scrub and fern, the cold and wet of these high and, then, out-of-the-way regions, and absence of roads, &c., much retarded the development of the field. The third rush, in 1856, brought the subsequent possessors of large fortunes, many among them Swiss, which gives Daylesford at the present time almost the character of a Swiss settlement. The Township lead was discovered by Brocklehurst and party in 1860, and the Wombat Hill lead shortly after. They both head from the cap of the reef belt. Near the head of the Township lead the Union Company obtained from under Victoria-street, in front of the Church of England, £25,000 worth of gold in two years; whilst the Royal Oak Company, on the Wombat Hill lead, near the north-east corner of the township, are said to have obtained £80,000 worth of gold.

The country is traversed by races (tier upon tier, to the number of four, on the Jim Crow Creek) along most of the principal creeks; and it is stated that in 1872 there were over 240 miles of these in the Hepburn district, as Daylesford was then called.

No descriptive records are now obtainable—in fact, few were made in the earlier diggings days—of the character of the leads, or the quantity of gold found; and, as the old workings on the leads themselves are mostly fallen in, no information can now be obtained by personal observation.

Lower Pliocene (Oldest Gold Drift).

The drifts of this age are only identifiable in the eastern portion of the sheet at the Wallaby diggings, of which Mr. F. M. Krausé has already given a description.

Middle Pliocene (Older Gold Drift).

So much denudation has taken place in Tertiary times that the old river drifts, with their protective covering of basalt, have given place to new river valleys, at a much lower level (nearly 200 feet); and but little of either the drift or the basalt remains, and that only as isolated fringes and small tabletop outliers down either side of the valleys which it once filled. The lower sub-basaltic leads—for there are two drifts under separate flows of lava—may be older than where I have placed them; or the upper ones may be younger, which, from their character, I think they are—their gravels being very slightly rounded, and containing much floating reef (sandstone). It is stated that the gold found to the west of Sailors' Creek is more nuggety and of better quality than that to the east.

The Wombat Hill and Township leads both have their sources under the south-west slope of Wombat Hill, and have been already described by Mr. Krausé (*Progress Report, Geological Survey of Victoria*, No. V., page 91). The Wombat Hill lead was lost near Leitch's Creek, and a series of bores were put down on this creek by the Government in an endeavour to pick it up. The Leitch's Creek Company took up the ground bored over, erected a plant, and did a good deal of prospecting, with very little success. The company has since been wound up.

Where the Concordia lead (at the Hon. W. E. Stanbridge's) joins the main lead at the Exchequer Company's shaft layers of sandy mudstones and purplish argillaceous shales occur, containing well preserved impressions of gum leaves (*Eucalyptus Pluto*; McCoy)—see *Prodromus of the Palæontology of Victoria*, decade 4, page 29, plate 39. These leaves are accompanied by a *Pteris*. The leaf beds rest on a black clay, and that again on the auriferous gravel drift. About 6 chains north-east of the Exchequer claim a subsidence in the surface shows the position of the junction of the Concordia and Wombat Hill leads. I quite agree with Mr. Krausé in his observations as to the probable course of this lost lead (see his report above mentioned.)

The Italian Hill lead, first opened in 1857, crops out north-west of the reservoir on Wombat Creek, follows the edge of the basalt for some distance south-easterly, crosses Paganetti's tunnel twice in a curve from north-east to north-west towards the British Empire shaft, and from thence south-easterly to the Royal Standard shaft, where it was 35 feet wide and patchy.

The Long Tunnel, Italian Hill, was commenced about 30 or more years ago, and has been worked ever since. At 500 feet from the mouth a quartz reef, supposed to be Collier's reef, 18 inches thick, was cut, dipping west at 60° (on the surface it dips easterly). At 1,000 feet a flat reef, 12 feet thick (supposed to be the Cornish), was met with, dipping westerly at from 30° to 50°, the country dipping easterly. At 2,150 feet is a reef 20 feet thick, dipping west at 80° (country now dipping westerly). The underground workings extend for, I might say, miles in all directions; and as there is no survey of it, and I was not allowed to make any, I was completely at fault as to the direction of the leads. Mr. Krausé remarks—"The search operations of the Long Tunnel Company promise to remove some of the uncertainty at present felt with regard to the older drainage system south-east and east of Daylesford." This promise has not been fulfilled.*

The Magenta, Federal, and numerous other tunnels I have no information about. They are mostly abandoned and fallen in.

The Spring Creek lead lies from 50 to 80 feet below the level of the Elevated Plains lead, and carries much basalt as washed boulders, showing its newer age. It crops out from under the basalt north-east of the old school-house, although an auriferous wash (probably the left bank of the lead) has been worked along the edge of the basalt to near the Chinese camp.

The Elevated Plains lead is from 6 to 10 feet wide, with from 6 to 36 inches of washdirt. The headings consist of black clay, but sometimes the basalt rests directly on the wash. A silicified tree trunk was found here.

At the junction below A the lead forms a flat, from 30 to 90 feet wide, which was very rich. Mr. Hart, a member of the Mining Board, who worked 600 feet of the gutter at A, says that it yielded on an average 3oz. 2dwt. of gold per lineal foot.

The above two paragraphs are from Mr. Krausé's field-book.

The Shakespeare Company bottomed their shaft at 127 feet on wash with gold. They went through:—

First rock	... 83 feet grey vesicular basalt, showing fluidal structure—some nodular and dense.
Clay and light gravel ...	... 1 „
Second rock	... 24 „
Clay	... 15 „
Drift-water heavy ...	... 4 „
On sandstone bar ...	... 127 feet at one end of shaft, 129 feet at the other, dipping 2 feet in length of shaft.
In reef ...	... 11 „
	138 feet.

The first plant was burnt down, and another put up; but, after much prospecting with small results, the mine was abandoned.

The Old Shakespeare shaft to the south is 118 feet deep, and was driven 160 feet north-east to the gutter, with a jump-up of 7 feet. The gutter was from 30 feet to 50 feet wide, and fairly rich. A reef called the Shakespeare South is said to cross the gutter, and a trial crushing of 9 tons to have yielded 20oz. of gold. A shaft to the north-west was sunk 50 feet, and then bored to bottom at 101 feet. This lead is supposed to run down past the old Leviathan shaft on Mr. Dougall's property (formerly Parker's station), but I am inclined to the opinion that it goes off to the westward, where deep ground has been proved by bores on Mr. Gillies' land. The Leviathan in 1864 is said to have obtained an average of 4oz. of gold to the machine. The wash is scarcely rounded, and more of the nature of a reef wash. The following results are from the Mining Registrar's report:—

	Tons.		Gold, per ton. oz.	dwt.	gr.	
Quarter ending 31st March, 1889—	200	wash, averaging	0	1	0·24	from 130 feet.
„ „ 30th June, 1889—	270	„ „	0	1	0	„ 100 „

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* A fossil pine log was found in this tunnel, and forwarded by Messrs. Fumberger and Pozzi to Baron Sir F. von Mueller, and by him pronounced to be *Spondylostrobus Smythii*, the seeds of which are of common occurrence in our gold drifts.

The Table Hill lead was 50 feet wide, with reef wash from 5 to 6 feet thick, extending on either side to the edge of the basalt. Grey and red clay, with angular quartz gravel, intervenes between the basalt and gravel drift.

No deep leads have been definitely traced to the westward, but the Hard Hills (now Basalt Hill) and Bald Hill are largely tunnelled under, and some tunnels are still being worked there. On Shepherds' Flat some tunnelling is still going on at Frying-pan Plain and near the Excelsior-bridge. There are two flows of lava with drifts under each; the lower one is below the creek level at the flat and further down the creek, and is very wet. On the Deep Creek the basalt at Brandy-hot is tunnelled under, and also the Fiery Hill basalt and the Bullarook Plains. The Sailor Prince, Sailor Prince Extended, Ballarat, Princess Alexandra, and Smeaton Company have done a large amount of work in former years. The Sailor Prince Extended have a tunnel from the creek in a direction a little west of south for over 1¼ miles (5,000 feet of which is perfectly straight), with air shafts. From all accounts the leads discovered were too poor to pay.

The Corinella Company, in Egan's P.R., have recently abandoned their claim after much prospecting under the basalt. The shaft was at first 139 feet deep, with a level at 110 feet, from 80 to 114 feet of which was through solid basalt, the top 80 feet being made up of horizontally-stratified grits of various degrees of fineness. Brophy's old workings (a tracing of the original plan of which is appended, and on which is shown some of the new work) have been struck in the new works. In an easterly drive at the 190-ft. level (E. 25° N.), at 168 feet from the shaft, is a cross-cut, a few feet west of which is a synclinal axis; and the dip, which was previously east, is altered to west. At 28 feet north in the cross-cut is a section showing vertical "indicator" slates, full of pyrites, with quartz above dipping west, and some ferruginous quartz veins coming in on the east. In the 110-ft. level these "indicator" slates were also met with in the east drive, with the wash overhead dipping south. On the 24th July, 1890, I reported on this property to the company, and forwarded copy to the Department, from which I extract the following remarks:—"From what I can see of the drifts they are not of the character of an alluvial gutter wash, rounded or waterworn quartz being almost absent. There does not appear to be any defined gutter, the bottom being nearly level or slightly undulating, with a dip to west and south. The gold—which is nuggetty, well waterworn, and rich in character, is very patchy—and it is difficult to imagine that it cannot have travelled further than from the northern boundary of the paddock. . . . . The deposit has, to my mind, both in its manner of stratification and character, more the appearance of a lacustrine formation, which has been subsequently buried by a lava flow and bed of ashes, and that again followed by another series of horizontally-stratified beds of mud, sand, and floating reef. If there be any deep ground it will probably take a course from north-east to south-west to the west of the present workings."

The following are some puddling results from the Mining Registrar's returns:—

Long Tunnel, Italian Hill—

Quarter ended.	Tons.		Gold, per ton. oz.	dwt.	gr.	
31st December, 1886	—1,059	washdirt, averaging	0	1	19·25	from 150 feet.
31st March, 1887	—1,054	" "	0	1	12·95	"
30th June, 1887	—1,150	" "	0	1	14·62	"
30th September, 1887	—1,100	" "	0	1	15·49	"
31st December, 1887	—1,312	" "	0	1	17·59	"
31st March, 1888	— 700	" "	0	1	10·63	"
30th June, 1888	—1,200	" "	0	1	12·34	"
30th September, 1888	—1,060	" "	0	1	13·94	"
31st December, 1888	— 936	" "	0	1	21·71	"
31st March, 1889	— 900	" "	0	1	18·56	"
30th June, 1889	— 750	" "	0	1	17·37	"
30th September, 1889	— 675	" "	0	1	10·70	"
31st December, 1889	— 895	" "	0	1	16·49	"
31st March, 1890	— 685	" "	0	1	16	"
30th June, 1890	— 748	" "	0	1	0	"
30th September, 1890	—1,200	" "	0	0	18	"
31st December, 1890	— 700	" "	0	1	13	"
31st March, 1891	— 730	" "	0	1	20	"
30th June, 1891	— 459	" "	0	1	7	"
30th September, 1891	— 550	" "	0	1	17	"

Leitch's Creek, Coomoora—

30th June, 1889	— 600	washdirt, averaging	0	2	0	from 130 feet.
30th September, 1889	— 300	" "	0	1	0	"

Corinella—

31st December, 1889	— 52	washdirt, averaging	0	10	0	
30th June, 1890	— 500	" "	0	2	3	from 130 feet.
30th September, 1890	—1,900	" "	0	1	12	" 140 "
31st December, 1890	—1,100	" "	0	3	2	" 120 "
31st March, 1891	—1,330	" "	0	1	16	" "
30th June, 1891	—1,150	" "	0	1	9	" "
30th September, 1891	—1,120	" "	0	1	0	" "

Table Hill (Sutton and party)—

30th September, 1887	— 200	washdirt, averaging	0	2	0·60	from 40 feet.

Boots' Gully (Lewis and party)—

31st December, 1886	—2,440	washdirt, averaging	0	0	12	shallow.
31st December, 1887	—4,120	" "	0	0	12	"

Quarter ended.	Tons.			oz.	dwt.	gr.	
Hard Hill (Thomson and party)—							
31st March, 1888—	4,000	washdirt,	averaging	0	1	0	shallow.
31st December, 1888—	1,493	„	„	0	0	18	„
31st December, 1889—	1,527	„	„	0	0	22	„
Hunt's Flat (Cross and party)—							
31st December, 1886—	1,020	washdirt,	averaging	0	0	12	shallow.
31st December, 1887—	677	„	„	0	0	13·49	„
Italian Gully (Norris and party)—							
30th September, 1889—	360	washdirt,	averaging	0	0	16	shallow.
Boots' Gully (Liepold and party)—							
30th September, 1888—	Nugget of 55oz.						
Boots' Gully (Liepold, sen., and party)—							
31st December, 1888—	1,080	washdirt,	averaging	0	0	18	(approximate).
31st December, 1889—	1,429	„	„	0	0	22	„
31st December, 1888—	1,466	„	„	0	0	18	
31st December, 1889—	1,543	„	„	0	0	22	(approximate).
Butterfly (Lewis and party)—							
31st March, 1889—	1,100	washdirt,	averaging	0	0	20·94.	
30th September, 1889—	83oz. 15dwt. in nuggets (one 54oz. gold, worth £4 2s. 6d. per oz.)						
31st December, 1889—	545	washdirt,	averaging	0	0	22	
31st December, 1890—	2,513	„	„	0	0	17	
Dry Diggings (Clapham and party)—							
31st December, 1886—	4,000	washdirt,	averaging	0	0	12	shallow.
31st March, 1888—	4,000	„	„	0	0	12	
31st March, 1889—	1,800	„	„	0	0	21·33	
31st March, 1890—	1,920	„	„	0	0	20	
31st December, 1890—	2,260	„	„	0	0	17	
Dry Diggings (Hunt and party)—							
31st December, 1886—	1,880	washdirt,	averaging	0	0	6	
31st March, 1888—	740	„	„	0	0	12	
31st March, 1890—	1,212	„	„	0	0	20	
Dry Diggings (Sawpit and party)—							
31st December, 1886—	800	washdirt,	averaging	0	0	6	
Dry Diggings (Shimmins and party)—							
31st December, 1886—	824	washdirt,	averaging	0	0	6	
Dry Diggings (Pride and party)—							
31st December, 1886—	1,100	washdirt,	averaging	0	0	12	
Dry Diggings (Kirkham and party)—							
31st December, 1889—	1,783	washdirt,	averaging	0	0	22	

That the mines now are giving as good returns in depth as they did when shallower in 1872 is proved by Mr. Smyth. In that year the mills crushed 53,543 tons of quartz, for an average yield of 6dwt. 12·3gr. of gold per ton; 427 tons of quartz tailings gave an average of 4dwt. 15·3gr.; and 11 tons of pyrites averaged 1oz. 13dwt. 2·3gr. per ton; puddlings amounted to 2,905 tons, averaging 3dwts. 5·6gr. This last appears to be better than anything obtainable now.

I do not for a moment suppose that the Daylesford leads are exhausted. Many undiscovered tributaries must still exist under the rich agricultural areas of the south-eastern portion of the district; but the land is now all private property—at least all that is worth mining under; and many obstacles are thrown in the miner's way, which he has not the means of overcoming.

UPPER PLIOCENE (RECENT GOLD DRIFT).

The Upper Pliocene deposits are more largely represented on the east side of the sheet than elsewhere. At Coomoora there are surface deposits of a pisolitic basaltic conglomerate, composed of iron oxide, volcanic ash, and quartz gravel (mostly angular). Along the flanks of the Sailor's Creek ranges they consist of red clay, with rounded flat blocks of sandstone, boulders of waterworn basalt, quartz, and slate. In some places it consists almost entirely of basalt boulders.

POST-PLIOCENE.

A large number of the once grassy alluvial flats, especially in the neighbourhood of lines of reef, are now transformed by sluicing into abrupt gorges, from 10 to over 30 feet deep, and in places several chains wide, down to the bed rock, every hole and crevice of which have been carefully scraped out. These operations were at a stand-still in 1886 for want of water. Sluicing operations have been largely carried on lately at Brandy-hot, Butterfly, Boots', Shicer, Welcome, and Green gullies, and in the Corinella Paddock; and some fine masses of rounded quartz with strings of gold (one weighing 73oz., and yielding, on breaking up, over 50oz. of gold) have been obtained. These point to a rich reef yet to be found, and now being prospected for by White and party in Boots' Gully. It is most probably in the bed of the gully and covered by alluvial.

THE MINERAL SPRINGS.

The neighbourhood of these springs is always indicated, in the summer months, by the deposited crusts of their contained salts (due to evaporation) over the shingle of the creek beds; but, in many places the absolute locality of the spring itself is entirely obliterated by the filling up and levelling of the creek bed by the débris brought down by successive floods and tailings from old sluicing operations. Wherever they are accessible even they are often wantonly destroyed by the boys of the district. Several analyses of the waters of the principal spring at Spring Creek, Hepburn, have been made; and, from the great differences of the mineral contents, it would appear that its constitution is not stable. In *Transactions of the Victorian Philosophical Institute,* 1851, is a quantitative analysis by the late Dr. Maund, Government Analyst, as under :—

	Per lb.—grains.	Per gallon—grains.
Carbonate of lime	4·747	47·470
„ magnesia	2·570	25·700
„ soda	4·380	43·800
„ iron	0·100	1·000
Chloride of sodium	0·640	6·400
Sulphate of soda	0·223	2·230
Phosphate of alumina	trace	trace
„ lime	0·030	0·300
„ iron	0·182	1·820
Alumina	0·100	1·000
Silica	0·330	3·300
Organic matter	0·097	0·970
	13·399	133·990

The free carbonic acid gas was not ascertained, but Dr. Maund thought, from his experiments, that it would be about 100 cubic inches of gas in 100 cubic inches of water. As regards its medicinal properties, Dr. Maund says—" The medicinal effects of the Hepburn water (and waters of a similar kind) are not of a slight character. The excess of carbonic acid makes them refreshing and exhilarating, and useful in allaying nausea and irritation of the stomach; while the salts they contain act directly on the renal and digestive organs, rendering the waters extremely beneficial in hepatic, gouty, rheumatic, and other affections.

The following are two analyses by Mr. W. Johnson, late Government Analyst :—

Contents of One Imperial Gallon.

	Grains.		Grains.
Carbonate of lime	20·0		34·40
„ magnesia	5·2		15·12
„ soda	1·0		36·50
„ iron	7·0		2·90
Sulphate of soda	28·8	Sulphuric acid (otherwise combined)	2·0
„ alumina	3·0	Alumina	4·40
Chloride of sodium	3·0	Chloride of magnesia	1·20
Silicious and clayey matter	4·0	Chlorine (otherwise combined)	2·2
		Silica	3.80
	72·0*	Traces of potash	0·00
			102·52†

* Carbonic acid gas, 150 cubic inches.

† In addition to the solid constituents, the water contains in one gallon—

Extra carbonic acid (in combination as bicarbonates)	77·8
„ „ (in free state)	97.9
	175·7

The reddish-brown sludgy deposit round the margin and in the water-course of this spring consists according to a qualitative analysis made in the Geological Survey Laboratory many years ago, of—

Carbonate of lime and magnesia,
Sulphate of lime,
Hydrous sesquioxide of iron,
Alumina,
Phosphoric and silicic acids—strong traces,
Insoluble substances—clayey matter and quartz sand.

Specimen No. 36 is a deposit from Mackay's Spring.

These springs all occur in the immediate neighbourhood of basalt flows, but whether there is any connexion between them or not, there is no evidence to show. They are all very similar in character, with the exception that some are more ferruginous than others. The following are other localities of these springs :—

Deep Creek, near north end of Fiery Hill.
Sailors' Creek, near Tipperary Point.
Boots' Gully, at north end of Hard Hills.
Mackay's selection, 30 chains east of Excelsior-bridge, Jim Crow Creek.
Kangaroo Creek.
Wombat Flat, near bridge.
Leggatt's (in creek behind).
Creek in south-east corner of Corinella Paddock. (Not on plan.)

Heights above Sea Level.

	Feet.
Railway Station	2,020·18
Post-office doorstep	1,918 21
Freehold United, surface level	1,842·89
Cornish and York	2,030·94
South-east angle R. C. Church reserve	1,976·51
No. 1 North Cornish	1,964·99
Fearnot	1,950·86
North Cornish	1,980·70
Cornish	1,995·92
Old Argus No. 1	1,985·62
„ No. 2	1,926·98
South Argus	1,915·23
Wombat Hill	2,191·91
Mount Franklin	2,092
Elevated Plain, by aneroid (approximate)	1,879
Francis' (now Avison's) Dry Diggings, by aneroid (approximate)	1,679*
Hepburn Post-office „ „	1,450
Shepherds' Flat Post-office „ „	1,104
Albert-street west, top of range „ „	1,930
Mineral Spring, Tipperary Point „ „	1,520
Sailors' Creek, at Milkman's-bridge „ „	1,500
„ Bryce's Flat „ „	1,415
Range top, east of Milkman's-bridge „ „	1,745
Basalt outlier, west of Milkman's-bridge „ „	1,647
Bald Hill „ „	2,000
„ creek at crossing to Hard Hill „ „	1,615
Liepold's, Hard Hill „ „	1,665
Sailors' Hill, above Pescia's „ „	2,045
Blanket Flat—Mayson's „ „	1,795
Mason's, Bullarook Plains „ „	1,785
Porcupine Crater rim „ „	2,009
McLaren's, Basalt Hill „ „	1,500
Deep Creek, near lagoon „ „	1,355
Three-mile post, Ballarat-road „ „	1,970
Blanket Flat East „ „	1,945
Corinella shaft „ „	1,910

Other railway levels are given on the plan.

REPORT ON THE MALMSBURY AND LAURISTON GOLD-FIELD.†

(*By E. Lidgey, Assistant Geological Surveyor.*)

I have the honour to forward a plan of the gold-field of Malmsbury and Lauriston, together with transverse sections of the Russell's Amalgamated, South Russell's, No. 1 South Russell's, and O'Connor's Freehold Mines, with report on the same.

A portion of the plan has been plotted from the notes of Mr. A. C. Murray.

I have to acknowledge my indebtedness to Mr. E. J. Dunn, both for information received from himself and from his report on the Bendigo Gold-field. His report should be studied by all interested in mining, more especially by those having anything to do with "saddle reefs." A study of it, in conjunction with the present report, will probably make clear many points which, from the small amount of underground work done in this district, I have been unable to touch on.

I must also thank the mining managers, and others connected with mining in this district, for the great assistance they have rendered me in preparing these plans and report.

The area surveyed contains portions of the parishes of Edgecombe, Burke, Lauriston, and Drummond. The town of Malmsbury is situated on the main railway line from Melbourne to Bendigo, and is distant from Melbourne 63½ miles, in a north-north-westerly direction. Lauriston is three miles south of Malmsbury, and about the same distance from Kyneton, from which town cabs ply at regular intervals during the day.

The Coliban River winds through the central portion of the area surveyed, flowing into the Victorian Water Supply reservoir, from which Castlemaine and Bendigo obtain their principal supply of drinking water. The Kangaroo Creek also empties into the reservoir. Back Creek, to the west of the Coliban, flows through the parish of Drummond, being separated from the Coliban by a strip of basalt. Both the Back Creek and Kangaroo Creek are dry during the summer, but are fair-sized streams during the winter months. On the east the Campaspe River winds slowly northward.

The greater portion of the field is covered with flows of basalt, having been cut through in places by the denuding action of the Coliban River and Back Creek. The basalt forms a high plain, being from 1,460 to 1,650 feet above sea-level, Malmsbury Railway Station being 1,492 feet above sea-level. Belltopper Hill, to the west of Malmsbury, is the highest point from which a fine view of the whole country for some miles may be obtained. The region to the south of Lauriston is hilly, but not rough, sloping gently towards the Coliban River. The north-west portion of the field, in the parish of Drummond, and from there to Fryerstown, is in places rough and rugged, many of the hills being exceedingly steep.

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* 1,684 feet by railway survey.

† Geological plan may be obtained at the Mining Department. Price Six shillings.

The alluvium deposits in the valley of the Coliban are in some places rich and fertile. In the flats and gullies the alluvium varies in depth from a few inches to 20 and 25 feet. The soil formed from the decomposition of the Silurian rocks is generally poor, but would be very suitable for small fruits. The climate here being too wet and cold for most of the larger fruits and vines. The soil on the basaltic plain is usually fine, deep, and black—almost any crop growing prolifically—although in some places the basalt has not decomposed so readily, and the bare rock is exposed at the surface.

The greater part of the land in this area has been alienated from the Crown, and is now private property. A small portion in the parish of Burke, and portion of Drummond, is still Crown land. Fairly easy terms can be made with most of the land-owners for mining on their property, whilst in some cases the land-owners are only too pleased to see the mining industry flourish.

Timber suitable for mining purposes is plentiful in Drummond and in portions of Burke.

Water may be obtained all the year round from the Coliban and Campaspe, whilst, owing to the heavy rainfall of the district, no difficulty need be experienced in conserving as much water as may be required.

GEOLOGY.—LOWER SILURIAN.

The bed-rock of the whole of the area surveyed consists of Lower Silurian strata, either appearing at the surface or hidden beneath the basalt.

These Silurian rocks are regularly stratified, and consist principally of fine mudstones, shales, slates with distinct cleavage planes, sandstones varying from fine and soft (hardly distinguishable from shales) to a coarse and gritty texture, and quartzites both tough and brittle. Almost any degree of hardness may be met with in these rocks, those nearer the surface being usually more or less decomposed, whilst, as a rule, the greater the depth the harder the rock. Owing to the greater portion of this area being covered with basalt, and from the fact that the railway lines and principal roads are on the level surface of the plain, very few roads and no railway sections are to be met with laying bare the Silurian rocks. Good sections are occasionally to be met with where surface workings occur, and in many of the tunnels which have been driven.

Wherever exposed, on the surface or in mining workings, we notice that the beds of slate, sandstone, &c., are apparently dipping at all angles, yet, if carefully noted, we find that there is a fairly regular order maintained, and that where any beds are dipping to the west we find that for some distance the other beds are to a certain extent parallel, until a distinct change will be observed, and the beds are seen to dip east regularly. This change will sometimes take place suddenly, at other times the beds will be noticed to get flatter until some are almost horizontal or form an arch or trough just where the change takes place. Now it is just this change in the dip of the rocks which requires careful study and working out. If we can thoroughly understand all the changes that have taken place in the rock bands, and that have caused all the foldings, faults, slides, &c., so much shall we be nearer a satisfactory knowledge of the formation of the quartz reefs and the deposition of gold and other metals in them, and so much the more economically shall we be able to work our mines.

It is beyond the scope of this present report to go thoroughly into all the changes that have taken place since the beds forming the Silurian rocks were first laid down, yet it will be well, perhaps, to give a rough description of the probable changes that have taken place.

Although the strata are at present dipping at almost every angle, it must be remembered that the beds of slate, sandstone, &c., were first laid down in the sea in the form of muddy and sandy beds, in a more or less horizontal position. The presence of casts of Hymenocaris in the slates in tunnels to the south of Taradale show that those beds must have at one time formed a muddy sea bottom. The probability is that most of the beds in this district were laid down in fairly but not very deep water, there being few shallow water beds such as conglomerates, although many of the sandstones or even some of the slates may have been laid down in shallow water which was undisturbed by winds or currents. Some of the sandstones show signs of current bedding, that would be caused by the moving power of currents in either deep or shallow water.

The sections of tunnels, cross-cuts, &c., being usually only from 6 to 8 feet high, expose to view such a small portion of the earth's crust that it is often difficult to form a correct idea of the connexion between the beds thus exposed. If we could see exposed to view a section of the Silurian rocks, say a mile long and the same distance in depth, we should notice that the rocks are folded much in the form of waves, some larger than others, apparently moving from east to west, and in some cases fractured and crushed as if the crest of the wave had turned over and broken.

For the strata to have been moved from their horizontal position to their present one a great change must have taken place and much pressure must have been exerted.

It has generally been stated, and has to a large extent received acceptance, that the folding of these beds has been due to the "secular cooling" of the earth's crust.* But we must take into account that at the time of the formation of these beds the surface of the earth was cool enough for animal life to exist on, and it is very doubtful if the amount of contraction which has taken place since then has been by any means sufficient to cause the folding which has been produced. Volcanic action may possibly have had some effect on the folding, but is more likely to have caused faulting. The attractive influence of the sun and moon have also to be considered. But the movement which probably has had the greatest effect on the folding of the surface rocks, has been the rotation of the earth on its own axis.

It is very evident from the regularity of the folds, that whatever has been the cause, that the movements have been slow, and have extended over an immense period of time. Possibly the cooling of the interior of the earth has allowed a slight deformation to take place, and the velocity due to its rotation has done the rest. It is probable that this folding of the rocks is still proceeding, but so slowly that it passes unnoticed.

It has already been stated that the slates, sandstones, &c., were originally laid down on a sea bottom, and, therefore, more or less horizontally. Then during the lapse of time they have been subjected to forces which have had the effect of undulating them. The same action continuing until the beds became highly contorted, having much the appearance of waves. The arch of the wave being known as the Anticlinal fold, and the trough of the wave as the Synclinal fold. It is where these foldings take place that the main reefs of the district are formed.

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* A. Geikie, Text-book of Geology, page 926.

Saddle reefs, as worked in the Energetic, May Queen, Napier, Russell's, South Russell's, and so extensively worked in the Bendigo district, being formed in the Anticlinal fold, and trough reefs as now worked in Russell's Amalgamated, and Russell's South, being formed in the trough or Synclinal fold.

The direction of the Anticlinal folds are known as Axial lines, the position of four of which have been proved, the Kangaroo, Energetic, Russell's, and Napier. There are probably many more parallel lines, but owing to the fact that little or no mining has been done off the known lines, and that so large a portion of the field is covered with basalt, they are as yet unknown.

[*] *Dip.*—Horizontal rocks have no dip, but owing to the manner in which the stratified rocks have been disturbed all trace of the original bedding has disappeared, and the rocks are inclined in some direction; the inclination at right angles to the strike is the dip, and it ranges from low angles up to vertical; in following out the lines of "centre country," or the axis at the surface, the dip of the rocks is the chief guide, and when distinct centre country is found the dip on each side determines whether it is a Synclinal or an Anticlinal axis, for if the dip on the east side be to the east, and on the west side to the west, it is clearly an Anticlinal axis or ridge, while if the dip is to the west on the east side, and to the east on the west side, it is clearly a Synclinal axis or trough. The dip forms one of the essential features in all mining surveys, and in practical mining a thorough understanding of the dip of the rocks is indispensable. At the surface on hilly ground the dip is most deceptive, it is apparently always towards the centre of the hill; this is caused by the downward thrust of the loose surface material.

[†] *Pitch.*—The deviation of any bed from the horizontal in the direction of the Axial line is its pitch, just as its deviation from horizontality in a line at right angles to the Axial line is its dip. The average pitch of the trough reefs, as far as examined, varies from 27 to 30 degrees north, but the probability is the pitch will vary, and in some cases may be to the south. The pitch of the reefs undulating slightly. The determination of the change of pitch is important, and should be carefully noted in all future work.

Cleavage.—Cleavage planes in the slates are very well marked, and in some of the sandstones a rough cleavage is noticeable. In noting the rock structure, it is absolutely essential that the cleavage planes should not be mistaken for bedding planes. Often the bedding planes are very indistinct, whilst the cleavage planes are much more easily noticed.

MESOZOIC.

A small strip of mesozoic occurs in the sheet to the south of Lauriston, and extends for some distance further southward, containing pebbles of quartz, quartzite, siliceous sandstone, and porphyry; is probably of the same age as the glacial conglomerates of Wild Duck Creek.

LOWER PLIOCENE

is here represented by the deep leads of the district, in no places exposed at the surface, but either covered with basalt or Upper Pliocene drift.

UPPER PLIOCENE.

The auriferous drift of the upper portions of the Welcome and Belltopper leads may be classed as Upper Pliocene.

NEWER VOLCANIC.

About two-thirds of the area surveyed is covered with basalt at the surface. To the west of the railway line from Redesdale Junction to Redesdale the basalt is fine and compact, and has been extensively quarried for building purposes. In other places it varies from fine and compact to porous and vesicular. There have been two, and in some places three, distinct flows, separated by clay beds. To the south-east of the Malmsbury Cemetery a quantity of menaccanite occurs in the basalt. Some fine needles of arragonite are found to the north-west of Malmsbury.

ALLUVIAL.

The alluvial deposits are those which are at present being formed from the denudation of the surface of the land, and consist of gravels, clays, sand, mud, loam, &c., forming the drift of the present flats and gullies. Many of these flats and gullies are auriferous, notably so where they cross or run with the belts of auriferous rock. It is more than probable that many of the gullies in which no prospecting has been done may prove to be also auriferous. The gullies and river flats on the volcanic tract contain some of the best soil in the district, although in very wet seasons the soil becomes too clogged.

QUARTZ MINING.

Russell's Reef Amalgamated.—This mine includes several leases in the town of Lauriston, and has been worked for several years with satisfactory results. There are two shafts on this property—the old or No. 1 shaft being 334 feet from the southern boundary, whilst the new No. 2 shaft is 1,460 feet north of the old shaft; depth of old shaft, 460 feet; depth of new shaft, 495 feet.

The most noticeable feature in this mine is the occurrence of "trough reefs," from which the greater amount of the gold has been obtained. The first one, which was originally worked from the surface at the south of the present shaft, is known as Russell's Reef. The reef, when first worked, was 70 feet wide, with a pitch to the north of about 30°. All the old workings on this reef are now filled in.

The second trough reef, known as the Incline Reef, has been worked to the southern boundary of the lease, and for a distance north of about 800 feet. The eastern leg of this reef has been worked to the surface, only a portion proving payable. For a distance of 30 feet from the bed of the trough, the quartz upon the leg was very good, then poor and barren quartz for about 150 feet; from there to the surface very good. The pitch of the upper shoot of gold is approximately parallel to the bed of the trough, varying from 27° to 30° to the north.

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[*] Report on Bendigo Gold-field, E. J. Dunn, F.G.S., pages 11-12.

[†] Report on Bendigo Gold-field, E. J. Dunn, F.G.S., page 12.

A true "saddle reef" was also proved to the east of the trough reefs, but so far little work has been done on it, except to take out a few crushings, which are stated to have just proved payable.

The strata as exposed in the cross-cuts and tunnel consist of coarse and fine sandstones, varying in colour from almost white to grey, yellow, red, and brown, mostly soft near the surface, and becoming harder at a depth. Several of these beds of sandstone show signs of a rough cleavage. The most noticeable of which are—

Compact sandstone, dip W. 8° S. at 59°, cleavage, 69° E.
" " 9° " 82°, " 42° "
" " 9° " 72°, " 53° "

Some of the sandstones are traversed by fine quartz veins and spurs, whilst other beds show signs of false bedding, and contain in some cases lenticular patches of small pebbles. The thickest bed of sandstone is 44 feet through, varying from that to 1 inch in thickness.

The finer beds consist of shales, slates—white, grey, blue, and striped, some containing a large percentage of pyrites. In most cases the cleavage planes are very noticeable in these slate beds. The westerly cleavage varying from 35° to perpendicular, with an average of 78°. Easterly cleavage varies from 55° to perpendicular, with an average of 76°. The angles formed by cleavage and bedding planes vary from 45° to parallel where the cleavage and bedding planes coincide; the average of 68 measurements being 15½°. As a rule, the greater the angle formed between the cleavage and bedding planes the nearer "centre" or "trough" country. The cleavage where the anticlinal and synclinal folds occur is usually contorted or "curly."

The dip of the beds (not including the folds) varies considerably. Those dipping east vary from 49° to perpendicular, the average of 143 dips measured was 76°. Those dipping west vary from 46° to perpendicular, the average of 160 measurements being 77°. Thus a few of the westerly beds are a little flatter than those on the east, but, as a whole, the easterly beds are 1° flatter than the westerly ones.

The transverse section of this mine shows the strata exposed in the cross-cuts and tunnel with position of the trough reefs, and shows the work done on the eastern leg of the saddle reef. Sufficient work has not been done on this saddle to give a perfect section. It will be noticed that these reefs are not vertically below one another but have a list to the east in descending.

Future Work.—The necessary future work in this mine consists of sinking, further cross-cutting, and thoroughly proving both centre and trough country. Wherever cross-cuts pass through centre or trough country rises and winzes should connect those cross-cuts, as rich reefs or masses of quartz may occur in the folded country between those cross-cuts, and yet no sign of such quartz be visible in those cross-cuts. The present cross-cuts on each level should be extended west to explore that country, and particular notice should be taken of any change in the strata which would indicate centre country, as it is probable a line of true saddle reefs will be met with in that direction.

On the surface there are efficient pumping, winding, and crushing plants.

South Russell's.—This mine is immediately south of and adjoining the Russell's Amalgamated, and includes the lease formerly known as Russell's Extended.

The main shaft is 306ft. 6in. deep (28.10.93). On the surface there are efficient pumping, winding, and crushing plants.

The reefs worked in this mine are a continuation southward of the Incline Reef worked so successfully in the Russell's Amalgamated and another trough reef below the Incline, which has been struck in the Russell's Amalgamated since that mine was inspected.

The bed of the Incline Reef was cut here at the 130-ft. level, and has been worked south for 90 feet with good results. Pitch of reef north at 30°. The reef was 10 feet thick, the whole of which stone was taken out and crushed, both legs being worked up to the 100-ft. level, above which the reef does not appear to be worth crushing.

The lower trough reef, which has received no definite name, has been partially worked to the southern boundary, there yet remaining a large amount of stone to be taken out and crushed. As a rule the richest stone was in the trough, and for 6 or 8 feet up on each leg, the eastern usually being richer than the western.

The eastern leg in being followed up makes into a saddle reef, as shown in the section. This saddle was payable, almost the whole of the stone having been taken out and crushed.

In opening out at the 275-ft. level a quartz spur was met with, a cross-cut being carried along this at a bearing of S. 20° E. for a distance of 72 feet where it joined the trough reef. This spur varied from 1 to 4 feet thick with an underlie N. 20° W. at 27°. The whole of the spur was payable, and has every appearance of continuing in depth.

Bearing of strike of trough reefs, 344° 15′; pitch, 30° N.; underlie of east leg, 35°; west leg, 38° near trough but reaching a higher angle farther from the trough.

The strata here are somewhat similar to those exposed in the Russell's Amalgamated. Sandstones, soft, medium, and hard; fine and coarse grained; none very coarse; hard and soft slate showing cleavage planes. The sandstones in centre country being exceptionally hard. The beds have a rather flatter dip than those in the Russell's Amalgamated, the dip east being from 50° to 84°; average, 69°; whilst the dip to the west varying from 47° to 78°; average 63°. In taking these averages it must be remembered that far more country has been opened up in the Russell's Amalgamated. Cleavage planes dipping east range from 73° to perpendicular, with an average of 76°. Cleavage planes dipping west range from 75° to perpendicular, with an average of 77½°. The angles formed by cleavage and bedding planes vary from 2° to 41°, the average being 16°.

The "list" of the trough reefs from perpendicular is about 7 feet in 100 feet in descending.

Future Work.—The remarks in connexion with the future work of Russell's Amalgamated apply equally to this mine.

No. 1 South Russell's is immediately south of and adjoining the South Russell's; a small lease of the ground, on which the church stands, with a narrow strip of the footpath, being held by Mr. Holmes. The company has a good winding and crushing plant at the surface.

The engine shaft, situated near the centre of the lease, is 387 feet deep (8.11.93), and is being sunk still further. The old or whip shaft, in which the Western Reef was first struck, was sunk 102 feet, a cross-cut driven west 44 feet and east 264 feet cutting the Eastern Reef at 123 feet from shaft. The old shaft is 305 feet from the new one, on a bearing of W. 33° 30′ S.

As will be seen in the transverse section of this mine neither trough nor saddle reefs have been worked; but two underlie reefs, known as the Eastern and Western Reefs.

The Eastern Reef, which outcrops at the surface 223 feet west of the engine shaft, with a strike of north 11° W. This reef varies in thickness from 6 inches to 2 feet, and has been worked from the surface to the 277-ft. level; underlie rather irregular. As a rule, where the reef is flatter it is richer; and where steeper, poorer. The shoots of gold pitch north at about the same angle as the pitch of the country, namely, 27° to 30°.

The Western Reef, which is about 145 feet west of the Eastern Reef, has been neither so wide nor so rich. Varying from 3 inches to 1 foot in thickness, it has been barely payable. Both reefs have about the same pitch, and are of similar character in most respects.

The sandstones are mostly fine and hard; grey and yellowish. Some being very fine grained, merging into slates and shales. In several of the beds in the cross-cut east from the old shaft it is difficult to state whether they are actually slates, shales, or sandstones. No cleavage has been noticed in any of the beds, which can be distinctly classed as sandstone.

The slates are soft near the surface, becoming harder in depth; grey, blue, striped, and black, with cleavage planes well marked and distinct. The cleavage in all cases dipping west, varying from 73° to almost perpendicular, with an average of 81°. The angle between cleavage and bedding planes varying from 15° to 36°, with an average of 29°. The remarks made in connexion with the Russell's Amalgamated, "That the nearer either centre or trough country, the greater the angle between cleavage and bedding planes," apparently does not hold good when applied to this mine. Out of eighteen measurements the smallest angle was 15°, being only ½° less than the average of Russell's Amalgamated; the greatest angle being 38°, there being eight of over 30°. Thus, although the cleavage angles are greater, there is neither centre nor trough country. The causes and effects of this cleavage and its probable use in mining requires yet further study.

The dip of the beds as exposed in the cross-cuts is (with four exceptions, which occur in the cross-cut at the bottom of the old shaft) to the east, and varies from 65° to 84° with an average of 79°. The beds in reality have a slight roll in them, parallel to the roll in the Eastern Reef, which is shown in the section.

Future Work.—In this mine the immediate future work consists in cross-cutting east to prove trough country, and in extending the western cross-cuts to prove centre country, and to prospect for saddle reefs. Of course further sinking and opening cross-cuts at greater depths should be proceeded with.

McCracken's Freehold adjoins No. 1 South Russell's on the south. The main shaft has been sunk 200 feet. A cross-cut driven west, cutting the southerly continuation of the Eastern Reef worked in No. 1 South Russell's. There are also several prospecting shafts on this property. The Comet Reef which was worked near the south-east corner of this lease some years ago is stated to have given good returns.

No. 2 South Russell's lies to the south of McCracken's Freehold, across the Coliban River. A shaft has been sunk here but little work done.

Several leases lie to the south and east of No. 2 South Russell's, but little or no work has been done on them.

South Wyndham is immediately east of Russell's Amalgamated. A tunnel which was driven many years ago to intersect the Star Lead is the only work done on this property, and proves trough country. The tunnel is shown on the section.

New Wyndham is adjoining and north of South Wyndham. An immense amount of surface work has been done here. Many shallow shafts having been sunk, the returns from which are stated to have been good. The reefs or veins were rather flat, underlying west, and from 1 to 4 feet thick. Nearly all the work has been done west of centre country. By driving east there is every probability of striking centre country, with every likelihood of payable saddle reefs being discovered. The main shaft has a small pumping and winding plant, with a windmill used as an auxiliary pump. This is rather a good idea for a mine which has not a heavy flow of water, as the windmill after once fixing requires little attention, and consumes no fuel.

Russell and Palmer.—This lease is east of the New Wyndham, and contains many shallow shafts. The Perseverance Lead was worked, but no quartz mining is now being carried on.

North Russell's lies to the north of the Russell's Amalgamated. Not at present working. Machinery lying idle. Shaft falling in. Through this lease a continuation of the Russell's trough reefs should pass, and ought to be well worth working.

Energetic Line of Reef.—This line was at one time worked by four companies, known as the Energetic, Central Energetic, North Energetic, and North Star. In the Energetic, the shaft of which was sunk 513 feet, three saddles are stated to have been proved, but only the uppermost one worked to a depth of 200 feet. Little work having been done on the others. The Central Energetic main shaft was 250 feet deep, and stoping on a continuation of the Energetic saddle reef, carried down to about 200 feet. The North Energetic had one shaft down 160 feet, and worked the reef to a depth of 150 feet. The North Star sunk two shafts to a depth of about 230 feet, and did a fair amount of work. These four companies seem to have all worked on the first saddle reef found in the Energetic, leaving the two lower ones untouched. No work has been carried out here since about 1874, but this ground should certainly not be allowed to remain unworked, there being every prospect of good returns, if properly and systematically managed. A section of the workings of the Energetic, with a short report by Mr. H. Archdale, is given in the Reports of Mining Registrars for the Quarter ended 30th September, 1888. The following is a statement of the number of ounces of gold obtained from each claim up to 1874:—

	oz.	dwt.	gr.
Energetic Company	8,079	1	6
Central Company	8,123	12	2
North Energetic Company	616	12	18
North Star Company	5,189	12	12

North Russell's Consols.—Two reefs have been proved in this property—the Welshman's and Standard Bearer; but little work done on them. Not now being worked.

Govett's.—No work doing here.

Napier Line of Reef is to the north of, and probably a continuation of, the Wyndham line. A good deal of work was done here some years ago in centre country; but, as the nature of the folds was not understood, work was suspended as soon as the first make of quartz was worked out. It only requires further sinking in centre country to prove saddle reefs at lower depths.

Keating and Stephenson.—Not working.

The Kangaroo Line of Reef is west of the Russell's line, 160 chains. A great deal of surface work was done here some years ago, many shafts having been sunk, most of them to the east of centre country, several going down on the eastern legs. Some of the returns from here are stated to have been exceedingly rich.

One shaft on the Middle Hill, which was sunk 125 feet, is stated to have passed through twelve quartz veins during the first 90 feet of sinking, varying from 2 inches to 1 foot in thickness, all auriferous, but no further work was done on them. There are large bodies of quartz outcropping on the surface, carrying a small quantity of gold. This line of country is well worth prospecting at a depth. The deepest shaft yet sunk being 120 feet. Another shaft on the Middle Hill, which was sunk 60 feet, is stated to have gone through 20 feet of quartz averaging 3½ dwts. per ton. On the South Hill the principal shaft is 120 feet deep, and is stated to carry a reef 2 to 3 feet thick, and auriferous. This reef was proved for some distance south of the shaft, when it was cut off by a cross-course, south of which point it has not yet been traced. A lease is now being prospected to the south of the old workings.

The Aroona is on a continuation northward of the Kangaroo line, a quantity of rich quartz was obtained, but is not now being worked.

The Tommy Dodd, Brandenburg, Caledonia, and Milvains were all on a reef to the north-east of Malmsbury. The basalt covering the Silurian rock here is very thin. The line of reef is the most westerly in the field. Not working now.

The Burra Reef was worked some years ago, a shaft going down on the reef 150 feet; underlying east, some of the stone being stated to be very rich.

May Queen.—A saddle reef has been worked in this mine, and is probably a continuation northward of the Kangaroo line. Now undergoing re-organization.

O'Connor's Freehold.—About 3½ miles south-west of Malmsbury. The quartz reefs in this mine and of those to the north and south of it are in a different belt of country from those already mentioned. The reefs so far discovered also differ in many respects. In the workings in this mine one most noticeable feature is the almost entire absence of slate beds, and the intense hardness of the sandstones and quartzites, soft easily broken beds being conspicuous by their absence. The beds consist of sandstones, mostly very hard, some being traversed by many fine thread-like veins of quartz, others having a spotted and mottled appearance from the decomposition of pyrite, nearly all containing a large quantity of pyrite; some of the coarser beds being rather softer than the finer ones, and containing a few small pebbles about the size of peas, rarely any larger. The very few slate beds that are met with are hard, and contain much pyrite. The most noticeable beds are of quartzite, especially at the lower levels, the portions forming the hanging and foot walls of the reef are put through the battery with the quartz, with favorable results.

Dip of strata varies from 52° W. to perpendicular, with an average of 76° W.

Two reefs have been worked here—the O'Connor's and the Stackyard. The O'Connor's has an irregular underlie to the east, is from 10 inches to 4 feet thick, opening out at places, and forming links both laterally and horizontally. The richest stone was from the surface to the 200-ft. level, but good stone has been met with below that depth. Present depth of shaft, 700 feet. The stone is highly mineralized, containing in places a large percentage of stibnite (antimony sulphide) and the decomposition products of the same; sphalerite (Black Jack); pyrite; a very small quantity of galena being occasionally met with, and a little dolomite.

The Stackyard Reef is very similar in appearance to the O'Connor's, but has not been so rich. Both reefs occupy fissures or faults, and cross the country rock both in strike and underlie. A tunnel has been driven on this lease from the Back Creek for a distance of 616ft. 6in., and exposes beds very different from those exposed in the cross-cuts in the mine. In this tunnel, as will be seen from the section, the beds dip in all directions, and are very much faulted. The strata consist of sandstone, banded slate and sandstone, quartzite, beds of slaty sandstone containing quartz spurs, sandstone with fine quartz veins and spurs; slates, white, grey, green, and black; and mudstones. The cleavage of the slates varies from 65° E. to 83° E., with an average of 76° E.

There is a very efficient plant on the surface for winding, pumping, and crushing.

The Egyptian is situated immediately south of the O'Connor's Freehold. The shaft is down 610 feet. The southerly continuation of the O'Connor's Reef has been worked, and the northerly continuation of the Queen's Birthday. Reefs underlie east and pitch north. Not now working.

Queen's Birthday is to the south of the Egyptian. The reef worked here gave handsome profits, the richest portion being only 3 inches thick. The dividends paid amounted to £60,000. Not now working.

The No. 1 South Queen's and Queen's Extended are not at work now.

North O'Connor's, to the north of O'Connor's Freehold, is not now working.

Missing Link is being worked by a co-operative party, who are stated to be doing well.

Never Despair.—A lease at the head of Swanky Gully. A shaft has been sunk here 150 feet, a cross-cut east 100 feet cutting Hubberd's Reef, and a cross-cut west cutting another reef. These two reefs meet at the south end of the lease. A good plant was erected here, but little work done since. Thwaites and party have a tribute at the south of the lease.

The Belltopper Reef is being worked by Rose and party with satisfactory results.

The Hanover is to the north of the Never Despair, but it is now idle.

The Humboldt.—A shaft was sunk here 450 feet, and the reef proved to 150 feet. No work has been carried on here since the machinery was burnt down.

Several parties are prospecting in and around Taradale, but the majority of the mines are now idle. A report, with plans by Mr. Archdale, mining surveyor, of several of the mines in this district appeared in the Reports of Mining Registrars for the Quarter ending 30th September, 1888.

DEEP LEADS.

A series of deep leads, of which comparatively little is yet known, trends beneath the basalt, towards the position of the Campaspe River. The leads occupy what were formerly the gullies, creeks, and rivers which drained the surface of the land before the outflows of basalt, which now cover them to a depth in places of over 300 feet.

The Star Lead was first worked from the edge of the basalt (east of what is now the South Russell's shaft) in an easterly direction, turning near the Yarra Bend shaft to the north-east for about 50 chains. From the head of lead to the turn averaged 1 oz. to the load, but then became poorer, the wash being much wider.

The Dalhousie Lead was worked from a shaft sunk through the basalt to the north-east of the Lauriston Hotel. Trend of lead about north-east.

The Perseverance Lead.—Worked from a tunnel to the north-east of the New Wyndham. Worked for about 400 feet; wash 20 feet wide, not very good.

The Royal Standard, a tributary of the Glengonner Lead, takes its rise a few feet above high water mark, in the Malmsbury Reservoir, about 300 feet east of the Energetic line of reef. Worked in a south-easterly direction for 2,750 feet, when it junctions with the Glengonner; average width of lead, 28 feet; total yield, 4,300 ozs.

The Glengonner Lead.—Distance worked, 2,000 feet; average width, 45 feet. From the junction with the Royal Standard trends easterly, and was struck about 1,000 feet ahead by the McCracken's Company. Their shaft was not deep enough to reach the gutter, and was abandoned. Width of lead, 120 feet.

The Deep Lead Company had the ground proved by diamond drill, showing 3 feet of wash under 336ft. 6in. of basalt. A shaft was started but abandoned. This will be the main lead of the district, and trends approximately parallel with the Campaspe River. All the other leads evidently fall into this, but at what points is not yet known.

The Drummond Lead was proved in the workings of the Aroona, and trends north-north-easterly, more or less parallel with the Glenlyon to Malmsbury road. The Confluence, which is probably a continuation of the same, has been worked, as shown in the plan, and is stated to have given good returns. The wash was 250 feet wide, with four distinct gutters. This lead has been worked just across the Coliban; several tributaries have also been worked, one in the South Queen's Extended, but little work done. The Egyptian Company have been working on another tributary. In the Good Friday Lead the wash was 30 feet wide and payable.

The Belltopper takes its rise at the head of Swanky Gully, and was worked several years ago. Sinking from 12 to 100 feet on good wash. The Welcome is a tributary of the Belltopper.

The Ironstone Lead is a continuation of the Belltopper, and has been worked up to the junction with the Little Wonder, thence to its junction with the Park Lead in Ellis' Freehold.

The Little Wonder is a tributary of the Ironstone. Gutter, 15 to 20 feet, and very rich in places.

The Home Rule has been worked by tunnel from the Coliban River.

A series of leads also trends south-easterly from Taradale, of which the main one is the Park Lead, which junctions with the Ironstone, and then trends easterly towards the Campaspe. Several co-operative parties are working near the head of the lead. The New Golden Gate is the principal mine now at work. Their gutter is nearly level, very tortuous, and has been worked for about 3,000 feet. The wash is from 100 to 200 feet wide of heavy gravel. In sinking the shaft two flows of basalt were passed through. The upper one, 55 feet thick, soft vescicular rock; the lower one, 100 feet, hard dense basalt.

The Victoria Lead takes its rise in Victoria Gully to the east of Taradale. Sargeant and party have a tunnel in 1,000 feet on the lead. Andrews and party have sunk a shaft 60 feet on the wash, which is from 3 to 100 feet wide and 3 feet thick. The Victoria Junction Company have a good plant on the surface, and have proved the wash below, but have been much hindered for the past few months by a burst of water.

The West Junction are on a tributary of the Victoria Lead; shaft, 150 feet, on fair wash.

The Victoria Consols have the diamond drill at work, proving gutter.

ALLUVIAL WORKINGS.

Many of the gullies and flats have been worked for gold. In some cases only prospected with the dish, in others thoroughly sluiced. The principal of which are—Digging Gully, west of Lauriston, at the foot of the eastern slope of Kangaroo Hill; sinking from 6 to 12 feet with the gold heavy and shotty. Butcher's Gully, one of the tributaries of the Back Creek, taking its rise on the eastern side of Belltopper, was very rich and has been thoroughly worked. Swanky Gully, rising on the west side of Belltopper, and falling into the Back Creek. Violet Gully, to the north of Belltopper, has been fairly rich in places to its junction with Butcher's Gully. The flats on the Back Creek have also been worked satisfactorily. A little prospecting has been done in many of the other gullies, some of which have been payable. There are many gullies between Belltopper and Fryerstown which have apparently never been touched, but should be well worth prospecting.

DIAMOND DRILL BORES

Full particulars of diamond drill bores, which have been put down in this district, will be found in the Annual Reports of the Secretary for Mines for 1889 and 1890.

QUARRIES.

During the boom period the quarries to the east of Malmsbury were extensively worked, most of the stone going to Melbourne. This stone is a fine-grained anamesite, easily worked, and taking a fine polish. These quarries are mostly idle, a few of them supplying stone for monumental purposes. The positions of all that have been worked are indicated on the plan.

EXPLANATORY DIAGRAMS.

1. Original aspect of the Silurian strata before it was disturbed.
2. The same strata undulating.
3. The strata bent and folded, cavities formed along the anticlinals and synclinals, when filled with quartz forming saddle and trough reefs.
4. Diagram of trough reef showing the meaning of the terms used in reference to the reefs.
5. Diagram of saddle reef, from Mr. E. J. Dunn's report on the Bendigo gold-field, showing the meaning of the terms used in reference to the reefs.

REPORT ON THE QUARTZ REEFS AT REDCASTLE.

(By R. A. F. Murray, F.G.S., Government Geologist.)

I have the honour to report having visited Redcastle, and further inspected some of the quartz reefs referred to in my report of a year ago, besides some others which I did not then visit.

The Redcastle mine appears to be the chief one in which any important developments have been effected since I was last there, but those developments are of a gratifying character, and most encouraging with respect to the re-working of the many other reefs on the field which have lain for many years neglected, though once worked with good results.

In this mine, which I was unable to descend on account of water being up in the lower level during certain works in progress in the shaft, the manager, Mr. C. Nagel, informed me that he had cut the reef at the 350-ft. level to the eastward of the workings which I saw last year; that the walls are clean and 6 feet apart, the filling being alternations of quartz and mullock veins.

The stone raised and ready for crushing is of excellent quality, with gold well distributed throughout, and, as the battery in course of erection will soon be ready, good results may be expected.

The Curly Dog reef, in lease No. 6412, about 3 miles east from Redcastle, was referred to in my last report. It has been worked at intervals for fully a mile in length, and the alluvial gully running close to it has been exhaustively worked for alluvial gold. The greatest stated depth to which this reef has been worked is 200 feet, and it has yielded as much as 10 ozs. of gold per ton, and 4 to 5 ozs. per ton from stone taken 4 feet in thickness. It is recorded that the workings were abandoned owing to want of appliances to contend with the water, and that good stone was left under foot at the south end, where the quartz was clean and solid.

At the north end the reef was worked to 100 feet, where it was cut off by a break, and was not recovered. It appears that there were here several bodies of stone, varying in thickness from 4 feet downwards, and that the gold was fairly continuous along the course of the reef—not in small distinct shoots. From the apparently reliable accounts given of this reef, the work of re-opening and further exploring it is one that would be fully warranted.

THE BEAUTIFUL VENICE REEF.

There are four reefs about a mile eastward of Redcastle, the No. 1 or western line being the Beautiful Venice. The main shoot on this line has been closely worked along the surface for 200 yards, but other shoots of stone in the same course have been worked at various intervals.

The bearing is north by west, and the underlay to the westward, the thickness, as indicated by the old stopes, being 2 feet to 3 feet. The deepest workings are stated to be at 250 feet, where good stone was left under foot. Yields up to 15 ozs. per ton are reported. A supposed southerly continuation of this line was worked at intervals for about ½ mile to as much as 150 feet in depth, with yields up to 2½ ozs. per ton. the reef being somewhat split up into veins. About 100 yards to the east is No. 2 reef, which yielded at the rate of 15 dwts., and was worked to about 50 feet.

No. 3 reef, 200 yards east of No. 2, has been closely worked along the surface, and down to water level, about 200 feet for 100 yards in length. The best shoot of gold-bearing stone is stated to be 200 feet long, and to have yielded up to 12½ ozs. per ton. This reef has a bearing slightly west of north, and a westerly underlay, the old stopes showing a width of 2 feet between the walls.

No. 4 reef, 30 yards east of and parallel with No. 3, and known as Chapman's line, was worked for 400 yards in length at close intervals, and down to 200 feet, auriferous the whole way, and only abandoned on account of water, to combat which the former workers provided no reserve fund.

THE BLACK SQUALL (LEASE NO. 6435).

This reef is south, and on the supposed line of the Beautiful Venice, and the surface workings are 200 yards in length. The deepest workings are stated as being 100 feet in depth, and the reef, as left, was 2 to 3 feet thick, and gold bearing, yields up to 2 ozs. per ton having been won from it. From the description given it would appear that there is an "indicator" on the footwall side, which sometimes accompanies and sometimes diverges from the quartz, which latter is rich or poor accordingly.

An apparently southerly continuation of this reef, faulted to the eastward, has been worked to 70 or 80 feet for a short distance, the stone being 4 to 5 feet thick, with gold and also some antimony.

THE TARAGUNYAH (LEASE No. 6429).

There are three reefs in this ground, known as the eastern, the middle, and the western reefs.

The eastern reef is a shoot about 100 yards long, and the stone worked was 9 inches thick, the stated yield being 5 ozs. per ton.

The middle reef is the principal one of the group, and is 200 yards west of the eastern; it has been worked for 300 yards, the stone being about 2 feet thick at most, but yielding 4 ozs. to 5 ozs. of gold per ton when worked. The greatest depth attained is stated to be 120 feet, where water compelled abandonment. This reef, like the others in the district, bears slightly west of north, and underlies westerly, though nearly vertical.

The western reef is 80 yards west of and parallel with the middle reef, and appears to be a short shoot about 100 feet long, dying out at either end.

Although the above information as to former yields, depth to which the reefs were worked, and causes of abandonment, is obtained from statements made, I have no reason to question its accuracy, as it was given by those who actually worked in the ground in former times. Judging by the visible amount of work done, I feel justified in recommending renewal of operations on a better basis than in former years, and am confident that, as in the case of the Redcastle mine, the gold shoots in the reefs above described will be found to continue in depth.

NOTES ON THE GEOLOGICAL FEATURES OF AN AREA IN SOUTH GIPPSLAND.

(*By James H. Wright.*)

In working out a detailed exposition of the geological features of any large area in South-western Gippsland, the geologist is sure to encounter a number of difficulties and drawbacks that require not only a strong spirit of perseverance, but also a certain amount of physical endurance to overcome. The dense vegetation almost everywhere covering the ground renders travelling, when taken out of the beaten tracks, slow and laborious work ; while, at the same time, it considerably interferes with his chances of observation, by concealing the surface of the ground, and by greatly circumscribing his view. The climate is notably a wet one, and this circumstance tells doubly against progress in a country so rankly overgrown. The surface is broken up into ranges and gullies innumerable, and, while the latter are usually filled with an almost impenetrable vegetable growth, it is in them chiefly that the most useful geological data can be gathered. An eminent geologist from New Zealand, who some years ago made a brief tour of inspection through a portion of South Gippsland, on the conclusion of his trip expressed to the writer his opinion that the two prime requisites for the work were stout boots and a sound judgment ; and this view will doubtless be confirmed by all who follow up the study of the rocks in the densely-wooded hills and tangled gullies of the locality. Not the least important obstacle to progress in the unravelment of the geological record is found in the numerous faults that ramify the country in every direction, and add another element of complexity to the work.

Having devoted a considerable amount of attention to this interesting field, I purpose to set down in this paper the result of my observations as dealing with the basin of the Morwell River, and those of its western tributaries, and with portion of the Narracan Creek basin. The extent of country to be dealt with embraces about 100 square miles.

Throughout the area to be described there is a marked absence of fossils. With the exception of a few leaf impressions and the imperfect vegetable remains found in the lignite beds, no organic testimony has been met with on which to base a classification of the rocks in their proper systems. Their order had therefore to be determined by stratigraphical evidence. The following grouping of the rocks is based on such physical testimony. The order of sequence has been arrived at after careful examination of the whole area, in addition to which advantage has been taken of whatever data have been obtained in the diamond drill and hand bores put down. The grouping is as follows :—

7. Upper brown coals, &c., of Morwell and Latrobe basins.
6. Middle brown coals formed prior to the date of the intense disturbance of Tertiary times.
5. Delburn sandstones.
4. Ferruginous conglomerates.
3. Older basalt.
2. Lower brown coals, quartzite.
1. Mesozoic sandstones, &c.

The several groups will now be briefly treated under their respective headings, the localities where they occur being indicated as a guide to any who may be desirous of following up these investigations. Following this the leading faults will be traced, and the evidence bearing on their existence noted. Finally some deductions will be drawn as to the influence of these dislocations on the configuration of the existing surface, and their correlation shown in respect to a fault of primary magnitude.

MESOZOIC.

Throughout the area under consideration no rock older than the Mesozoic occurs at the surface, and it is more than probable that its whole extent is underlaid uninterruptedly by rocks of this age. Although the numerous vertical displacements of these rocks and their folded condition throughout precludes our arriving at any reliable estimate of their thickness, the diamond-drill bores which have been put down at various points show that the carbonaceous strata extend to very considerable depths. The bore at North Mirboo, which attained the depth of 2,700 feet, failed to get through the Mesozoic series ; while the deep bore in the Narracan Valley, though carried down to 3,000 feet, in like manner did not reach the underlying formation.

In the present state of our knowledge it is not possible to establish with certainty any extensive geological horizons in the Mesozoic rocks in the area under notice. There appears to be some similarity between the Boolarra and the Coalville coal-seams, both in the number and in the mode of occurrence. The evidence on this point, however, is still incomplete, though it seems probable that a connexion exists. At the two places named coal-mining has been carried out on a pretty extensive scale; but the work has not been attended with very satisfactory results, partly on account of the coal-seams being somewhat attenuated and partly on account of the ground being much disturbed by faults which, by interfering with the persistence of the seams, greatly increase the cost of winning the fuel.

QUARTZITES.

Overlying the Mesozoic formation we have the quartzites. I have only been able to obtain one section actually showing contact of these rocks, but the quartzites appear exposed in many places, and in nearly every instance there is shown evidence of their being laid down prior to the spreading of the basaltic sheet that covers so large a portion of the surface of South Gippsland.

The most extensive development of the quartzites is shown at Ordlaw, in the Narracan district. At this locality the quartzite beds are from 100 to 150 feet in thickness, and are overlaid by older basalt.

In structure the rocks consist of an extremely hard compact greyish mass of fine to coarse quartz grains, cemented together by silicious infiltrations. In some cases the weathered surfaces show the rock disintegrating to quartz sands and gravels, intermixed with yellowish ferruginous material. Interbedded with the dense rock appear occasional layers of indurated clay, containing abundance of leaf impressions. Weathered slabs of this hardened clay may be found, which on handling fall to pieces in thin and extremely brittle flakes, each lamination containing a more or less perfect impression of a leaf. I have obtained altogether from different localities where the quartzites occur eight distinct varieties of fossil leaves. Their classification, however, is still incompleted ; but they appear to be of Miocene or possibly Eocene age.

Near the northern extremity of the Strzlecki Range, about a mile due east of Coalville, another extensive exposure of the quartzites occur. It is difficult to estimate the thickness of the beds here, owing to the dip of the rocks conforming to the slope of the hill in which the exposure occurs. The rocks here preserve the same character as at Ordlaw, though the greyish tint prevailing at the latter locality often gives place to that of brown, pink, and red in the angular fragments scattered over the hill-side. The quartzites are here also overlaid by the older basalt, which stretches down the western slope to within a short distance of Coalville.

On Firman's Track, a mile and a half south-east of Ordlaw, the quartzites appear in the face of a small gully. They contain fossil leaves similar to those in the Ordlaw series.

The rocks again appear at a point about a mile and a half south of the exposure last noted. The situation is on the south bank of Saw-mill Creek. The outcrop is of a very limited extent; but I have been able to obtain the characteristic leaf impressions from the rocks.

Another exposure of the quartzites occurs a mile further to the southward in the north bank of Stony Creek. Here they appear to thin off considerably, the beds showing only 2 feet in thickness. Underlying them is a layer of coarse quartz gravel. There is a possibility, however, of this being merely an intercalation in a thick deposit of dense rock, of which the uppermost layer alone is exposed to view.

About a mile and a half higher up the Stony Creek Valley, on a small feeder called Dixon's Creek, there occurs at the surface, showing beneath the older basalt, an outcrop of rocks which, though differing from the quartzites in structure, evidently belong to the same system. These rocks, much decomposed at the surface, have been opened to view in a couple of shallow shafts from 10 to 12 feet deep. The beds thus exposed are seen to consist, in descending order, of a layer some 3 feet in thickness of moderately fine-grained, white, and rather soft sandstone, succeeded by about the same thickness of a denser, much finer-grained, yellowish rock of the same variety. This is underlaid by a bed of very soft and greatly decomposed brown sandstone, containing much ferruginous material. In these dark-coloured sandstones I obtained fossil leaf impressions similar to those met with in the Ordlaw quartzites.

Five miles from Dixon's Creek, in a south-westerly direction, and not far from the Darlimurla Railway Station, the quartzites have been proved to exist beneath the basalt in a shaft put down 50 feet in the latter. Half-a-mile south of this shaft the same rocks outcrop to a limited extent, being at this point covered by later Tertiary sands.

In all the foregoing instances of the occurrence of these silicious rocks at the surface, except that on Firman's Track, and the one last mentioned, they are found covered by remnants of the extensive basaltic sheet which forms so prominent a feature in the geological formation of the area under notice.

In one of the numerous gullies indenting the eastern slope of the Lydiard Range, and about 2 miles to the north of the Mirboo Railway terminus, the quartzites are to be found in contact with the Mesozoic sandstones. In the other instances already given the underlying strata are entirely concealed from view, and their character can only be conjectured on. Under these circumstances, the thickness of the quartzites themselves must of course also be a matter of inference. In the Lydiard Range Gully the quartzites do not present the bold precipitous appearance shown at Ordlaw ; and though the basal limit of the rocks may be seen, it is not possible to arrive at the exact vertical dimensions of the formation, owing to the loose rock débris covering it, and the absence of any apparent dip to serve as guide. Nevertheless, the thickness may be regarded to be not less than 100 feet. Angular detached pieces of the rock may be detected embedded in the soil, not only up the side of the gully, but across the eastern saddle forming it, and down the opposite slope, the massive rock itself occasionally appearing beneath the surface. The gully and its neighbourhood is thickly covered with fallen timber, and an extremely rank undergrowth which renders the locality not only hard to reach, but particularly difficult to explore. The quartzites are here overlaid by the older basalt, which is in turn capped by later Tertiary sands and clays. The outcrop of silicious rock again appears beneath the prevailing basalt half-a-mile to the north-east, along the Lydiard Range. Evidence of its existence may also be found for about a mile still further on, in the shape of loose boulders and angular pieces of rock to be met with in various water-channels leading from the range.

From what has already been stated, it will be evident that the quartzites are to be met with appearing at the surface over a very considerable extent of ground. For reasons to be given later on, I regard the various exposures I have here noted, not as indications of isolated patches of the rock, but as evidence of the existence of a widely extending bed.

LOWER BROWN COALS.

In the valley of the Narracan Creek, which lies near the north-western limit of the area here treated on, sections may be obtained showing a bed of brown coal about 14 feet in thickness, occurring beneath the older basalt. At the foot of the Railway bridge, midway between the Narracan Railway Station and Stewart's Falls, massive basaltic rocks may be seen *in situ* with the brown coal bed a few feet below, separated from the superincumbent rocks by a thin band of white plastic clay. The same clay band may be seen showing out under the basalt in various places in the vicinity; while the brown coal bed has been mined to some extent at two places further northward along the valley. I have not been able to find any evidence of the quartzites in this immediate locality; though traces of them, in the shape of detached fragments, occur on the western slope near Coalville, about 3 miles further down the valley. It is hardly possible that they exist under the brown coal beds here, as in places where favorable observations can be made, the Mesozoic rocks are seen to come in view a short distance down the hill-slope, on which no traces of quartzites appear. It will have been noticed from the remarks already made on the quartzites, that although they are exposed in many places over a wide area, wherever seen they are overlaid by the older basalt, or by later Tertiaries. At one of the places at which the brown coal has been mined on the western slope of the valley, at a point about midway between the base of the range and its summit, a deposit of coarse quartz gravel may be seen resting upon the brown coal bed at its exposed edge. This may be the equivalent of the quartzites at this place, unless the gravel should prove to have drifted to its present position from a higher level, where deposits of a somewhat similar character occur. So far, I may say, I have not met with evidence that would justify me in forming an opinion as to whether the Ordlaw series of silicious rocks is of older or later date than the brown coal alluded to, which are presumably of Miocene age, or whether the two are of contemporaneous formation.

BASALT.

Within the area under present consideration, the older basalt forms the existing surface of a wide stretch of country, chiefly on the western side. There is evidence that it also extends beneath the later Tertiary deposits throughout nearly the whole area treated on. In many places where it is concealed by these widely extending later deposits, the basalt crops out in the sides of hills and gullies; while in other parts where it is not visible at the surface, bores and shafts have disclosed its presence beneath the sands, drifts, clays, and brown coals of more recent date. In some of these localities borings show that the basalt attains a thickness of over 200 feet. At Darlimurla nearly 100 feet of the rock is shown in a face, while at other places the thickness is considerably reduced. Its presence is to be observed at the summit of the Strzlecki and Lydiard Ranges at altitudes of from 1,000 to 1,200 feet above sea-level. On the southerly and easterly slopes of the former range, from Narracan to the point where McDonald's and Lydiard's Tracks junction, it forms an uninterrupted stretch of surface, embracing about 25 square miles, originally covered by dense scrub forest, but now occupied by the clearings of the selectors. Passing beneath the later-formed Tertiary deposits from which it outcrops occasionally in small patches, the basalt again appears at Boolarra, Baromi, and East Mirboo, where it forms another wide area of hills and gullies.

Associated with the basalt we have frequently thin and apparently not very extensive deposits of iron ore in the form of limonite, and, more rarely, hæmatite, more or less impure. I am not aware of their having been met with far away from the exposed surface of the volcanic rock, to the decomposition of which they no doubt owe their origin, which may be, in some cases, of comparatively recent date.

CONGLOMERATES.

In almost every instance throughout the area we are considering, when the basalt can be seen covered by later accumulations, the deposits resting upon it consist either of compacted quartz gravels or of ferruginous conglomerates, more or less coarse and dense. The latter rock is composed of rounded quartz gravel and pebbles, bound together by a matrix of ferruginous material. Where these beds are exposed the gravelly surface usually gives indications of being derived from their disintegration.

On each of the ranges enclosing the Narracan Creek basin these conglomerates occur at a height of about 500 feet above the bed of the stream. Here they may be observed resting upon the older basalt at an altitude of 1,000 feet above sea-level. They may also be found occurring for some distance along both banks of Silver's Creek, when followed up from its junction with the Ten-mile Creek; along the crest of the range forming the northern side of the Stony Creek Valley, on the banks of Delburn Creek; and in various places on or near the crest of the long range whose slope leads down to the Little Morwell River. In each of these localities they rest upon the older basalt; while on the crest of the Lydiard Range, at an elevation of 1,000 feet above sea-level, they occupy the same position.

Where exposed, the ferruginous conglomerates are sometimes of a yellowish hue; but they are frequently to be met with of a dark-reddish colour, especially when found in detached pieces. In many cases this latter deepening of tint appears to be due to the action of bush fires.

Near the Darlimurla Railway Station, the conglomerate assumes the character of an extremely dense ferruginous quartz grit, whose weathered surface, unlike the more friable varieties, preserves a hard and smooth texture.

As might be supposed, these rocks occasionally pass into an impure quartzy variety of limonite, the ferruginous material in their composition being evidently derived from the neighbouring basalt.

The conglomerates are from their nature very liable to disintegration when they appear at the surface; and for this reason it is often difficult to form an exact estimate of their vertical dimensions; but they appear to range from a few feet up to 70 or 80 feet in thickness.

The gravelly accumulations sometimes taking the place of the ferruginous conglomerates in relation to the basalt are of considerable thickness. They are well represented in the neighbourhood of the Darlimurla Railway Station, where they exist as a far-reaching deposit from 20 to 100 feet in thickness. They have been met with in several of the bores that have been put down between North Mirboo and Boolarra; and they have proved a serious obstacle both to diamond drilling and to mining in the locality.

DELBURN SANDSTONES.

At Delburn Creek, and also at Silver's Creek, the ferruginous conglomerates are overlaid by what appears to be the remnants of a bed of fine-grained, yellowish, extremely dense sandstone, containing imperfect impressions of plant remains. The surface soil at the first-named place is evidently due to the decomposition of this rock, large angular pieces of which are scattered over the surface, and may be met with in digging. Between Yinnar and the Mountain Hût somewhat similar fragmentary pieces may be found in soil superimposed upon the basalt; but here the character of the rock is more gritty, and it appears in some specimens as though grading into the conglomerates.

DARLIMURLA (MIDDLE) BROWN COALS.

These are brown coal beds occurring in the Tertiary tract surrounding the Darlimurla Railway Station. I apply the term "Middle" to them because, though undoubtedly younger than the carbonaceous deposits of the same character underlying the older basalt, they appear, for reasons to be given later on, to have been laid down prior to the formation of those vast deposits of similar character which exist in the Morwell and Latrobe basins. When the age of these several deposits has been determined with more exactness than our present knowledge of them will allow it may be possible to distinguish them by the distinctive terms employed to designate the geological epochs of Tertiary times. For present convenience merely I use the terms Lower, Middle, and Upper, in dealing with the series.

These middle brown coals, with their associated deposits of clays and gravels, extend along the Little Morwell Valley between Darlimurla and North Mirboo. They may be seen outcropping throughout this stretch of broken Tertiary country in various places, and boring has also occasionally disclosed their existence. The area which they cover, however, is a limited one, in all probability not exceeding 8 or 10 square miles. Near the Darlimurla Village Reserve clay beds of this class, of considerable thickness and containing a small seam of brown coal, are exposed in the slope of the range. Close to the Darlimurla Station a deposit of brown coal 30 feet in thickness, underlaid by 40 feet of dark tenacious clay, has been partially explored. Near the junction of Boston's Creek with the Little Morwell River there occurs a band of dark clay thickly interspersed with lignite of a highly resinous character. The band is only a small one ranging from 2 to 4 feet, and forms the upper portion of some clay beds of unproved thickness. It is surmounted by quartz gravel, and can be traced over a considerable area.

UPPER BROWN COALS.

These vast carbonaceous deposits extend throughout the upper portions of the wide expanse of level country stretching from Boolarra to Morwell, and thence widening into the Latrobe Valley. They will again be alluded to, and at greater length later on.

FAULTS.

I have already alluded to the faulted condition of the rocks in South-west Gippsland. There is ample evidence of these dislocations to be met with in traversing the country; and the mining operations already carried out further tend to prove that this part of the colony has been subjected to disturbing influences of a very powerful character, the rocks where penetrated being found to be greatly affected by fractures and displacements, that prove both puzzling and expensive to those engaged in mining. These alterations in the original disposition of the strata have in a very large measure given the present configuration to the surface. No doubt denudation has had its share in the work; but, in the area under notice, this agency appears to have been directed to so great an extent by the folding and fracture of the rocks that, generally speaking, the one may be regarded as the complement of the other; and where we see evidence of extensive channel denudation we may as a rule conclude that some line of folding or fracture is not far off.

These rock movements, playing so important a part in the configuration of the existing surface, and affecting to so great a degree all mining operations that may be carried out within the sphere of their influence, must naturally be regarded as ranking among the most important geological features of the area in which they occur. I shall, therefore, in this paper deal with such of the chief lines of disturbance as from their location come within its scope, giving the chief points of the evidence bearing on their existence that has come under my observation.

The Mesozoic and other subsequently formed rocks of the district have doubtless been subjected to movements of which no evidence appears in the overlying formations; but in the majority of cases the great disturbances visible in the more recently formed rocks will also have influenced all underlying strata. It may be observed that in most of the instances of disturbance to be treated on here the movement has taken place, not only subsequent to the overflow of the older basalt, but later than the deposition of the ferruginous conglomerates and gravelly accumulations, and of some of the subsequently formed brown coal beds as well, for these formations are all to be observed cut by the faults attendant on the general disturbance of the strata in their neighbourhood. This brings the period of the occurrence well on into Tertiary times.

Taking the data that have become available after a careful examination of the area here treated on and broadly viewing the information thus accumulated, it would appear that it has in Tertiary times been subjected to a powerful compressive force acting in the main from the north-west and south-east, the axes of folding running mainly at right angles to these directions.

Over a large portion of the northern part of the area under review the prevailing rock is basalt, which from the nature of its occurrence does not furnish much information that can be relied on when dealing with the subject of rock displacements; but in places where the stratified quartzites appear at the surface some reliable knowledge can be gleaned as to what has taken place. Near the northern extremity of McDonald's Track the extensive exposure of quartzites shows a dip 21° to S. 40° E. They are surmounted by basalt. Following the line of dip over a very broken surface composed of Tertiary sands and clays and soils of basaltic origin for a distance of 2 miles, the next exposure of quartzite is reached near the junction of the Nine-mile and Ten-mile Creeks. The quartzite, which here also underlies the basalt, is visible here and there over a considerable area. I have traced it in a direction mainly coinciding with the line of strike for a distance of nearly 2 miles. In this neighbourhood is the fine exposure exhibited at Ordlaw, where the rocks rise boldly for 150 feet above the level of the creek. The inclination of the strata here is to the N.W. at from 23° to 30°. This dip is opposed to that prevailing at McDonald's Track. Judging from the high angles of inclination presented at the two points, and the broken nature of the intervening country, there is likely to be more than a single folding between them.

The next outcrop to be met with when following the line of undulation is in a small gully in the vicinity of Firman's Track, at a distance of about 1 mile from the locality just dealt with, and with which it nearly corresponds in altitude. The rocks are massive, and the dip well marked, the inclination being to N. 20 W. at 18°. There is again evidently some line of folding or fracture between the two places.

Continuing onward for a mile and a quarter in a course nearly at right angles to the line of strike the outcrop at Saw-mill Creek is reached. The exposure is limited at this place, and the dip obscure; but a mile further on, in approximately the same line, the quartzites again make their appearance, the outcrop being in the left bank of Stony Creek. Here the angle of dip is considerably reduced, being at 6° to N. 20° W. About a mile and a quarter further up the creek, and in a position slightly in advance of the strike line of the Stony Creek outcrop, the same rocks occur, showing a south-easterly dip at 15°.

In summing up the evidence thus obtained from the quartzites over a distance of rather more than 5 miles from point to point, it may be noted that, excluding intervening undulations, the outcrops occur upon a gradually sloping line, the north-westerly end being elevated about 1,000 feet above sea-level, and the opposite extremity about 300 feet. Throughout the south-easterly half of this line, the angles at which the rocks are inclined gradually diminish from the higher towards the lower end of the line. The flexions of the rocks may be either the result of a series of anticlinal and synclinal foldings, or of a set of parallel faults. On examining the vicinity of the exposures, for a solution of this question, I have come to the conclusion that in the Ten-mile and Stony Valleys there is absolute evidence of faulting, the lines corresponding in the main with the trend of the valleys. On the north-west bank of both streams, we have, in a steep face of some 200 to 300 vertical feet, the quartzites, basalt, ferruginous conglomorates, and later-formed Tertiary clays, &c., in the usual order, and with the dip opposed to the hill-slope; on the opposite bank we have a long and gentle slope extending it may be for half-a-mile or more, showing formations corresponding with the upper layers of the opposite hill crest. These appearances are evidently brought about by a break in the continuity of the strata, being either displacements of the ordinary character, or reversed faults with the thrust coming from a north-westerly direction.

Passing on to the next important depression, namely, that which forms the basin of the Little Morwell River and its tributaries, many notable examples are to be found of the powerful disturbances to which the rocks have been subjected. At the coal mine in this valley considerable work has been done in tunnelling and driving. The main tunnel was carried about 700 feet into the hill. Near the mouth of this tunnel a fault was intersected running N.W. and S.E., the hade being nearly vertical. Judging by the great thickness of rock débris occupying the space between its walls, this fault must be one of considerable magnitude. During the progress of mining, numerous throws were encountered, branching apparently from some main line in the vicinity; in fact, the opening up of this mine, which has since been abandoned, proved the locality to be beset with a perfect network of dislocations. As the measures were traced into the hill the dip of the strata proved to undulate considerably, finally going rapidly to N.N.W. In the cores obtained from a diamond-drill bore put down a little to the rear of the workings, I noted the dip to be from 45° to 48°, the ground from which they were got being apparently in a very disturbed condition.

In the neighbourhood of the mine the river appears to run for some little distance along the axis of a low and abrupt anticline, the rocks showing a sudden alteration in direction of dip which is 12° to N. 10° W. on the north bank, and 15° to S. 10° E. on the opposite side of the stream. About half-a-mile further up stream, the river course, viewing it against the flow, suddenly deflects in a westerly direction; but if, in place of turning with it, an undeviating line of advance be maintained, this will be found to coincide with the basin of a tributary stream named Burchell's Creek. The Mirboo Railway line crosses this creek near its junction with the main stream. In some cuttings, near the Railway bridge, the effects of the faultings may be traced in the Tertiaries, which now come into view, and consist partly of ferruginous conglomerates and later-formed gravel, sands, and clays, though the prevailing rock is of basaltic origin. It is, however, about a mile and a half up the valley that we meet with the most pronounced evidence of this channel marking a continuation of the line of faulting. The plication of the rocks here is of a most significant character. The Mesozoic sandstones form a steep range whose slopes are traversed by numerous steep gorges. These rocks are overlaid by basalt, which is in turn surmounted by the Tertiary clays, quartz gravel, &c., characteristic of the district. Evidence of a powerful anticlinal movement is here exhibited, the axis, as usual, running, roughly speaking, N.E. and S.W. On the north-westerly side of this line, I have obtained the following dips:—N.N.W. at 48°, and W.N.W. at 48°; on the opposite side, E.S.E. at 49°, S. 60° E. at 63½°, and E.S.E. at 57°. There are strong grounds for the belief that the dynamical forces that produced these results also gave rise to a fault of considerable magnitude, the line of which corresponds mainly with the creek's course. The basaltic bed appearing on the crest of the range has apparently been fractured through, and thrown down almost to the level of the creek bed. It may be that the steep south-easterly inclination of the sandstones is due to the sudden dragging down of the strata towards the downthrow side of the displacement. After a careful examination of all the surroundings of the locality, I have estimated that the amount of throw in this case cannot be less than 300 vertical feet. A rather curious feature in connexion with the disturbance of strata here is that the strain does not appear to have penetrated far into the rocks on the downthrow side. In a diamond-drill bore put down to 1,000 feet, and not more than 10 chains distant from a point where the rock dip shows the abnormally high angle of 49°, the cores obtained throughout were remarkably free from any signs of disjointedness, and showed the very moderate dip of 6°.

Coming back to the point of deflection in the Little Morwell River, near the junction of Burchell's Creek, and tracing up the former stream, it soon becomes apparent that we have in this valley either a branch fault or a bending westward of the main line of dislocation, the effects of which are so noticeable in the Boolarra Coal Mine. On following up this westerly line it becomes evident that it maintains a course corresponding in the main with the trend of the valley. Along the river for some miles the same general features are observable as have already been noted as existing in the Ten-mile and Stony Creek Valleys. A steep range runs with considerable abruptness on the right or northern side showing basaltic rocks and clays, ferruginous conglomerates, and later-formed clays, &c., of Tertiary age, in ascending order, with the dip opposed to the hill-slope ; on the opposite bank a gentle slope of the higher deposits butts upon the base of the hill face.

Near the eastern boundary of the Darlimurla Village Reserve, in a gully running transversely with the main depression, an outcrop of brown coal occurs. The seam, which is only a few inches in thickness, has been driven upon for a distance of 50 feet or 60 feet. The containing strata are dark carbonaceous clays of the class usually found associated with the brown coals of the district, but in conjunction with these is a band of clay, possessing a more distinctive character in that it is largely impregnated with mica. Here also occurs a bed of dark sandy carbonaceous clay, containing preserved leaves. These soon become brittle and flake off on exposure to the drying influences of the atmosphere. The features presented at this place will be more fully alluded to later on.

In the neighbourhood of the Darlimurla Railway Station the effects of faulting again become conspicuously noticeable. The range skirting the stream here rises to the height of 400 feet above the river channel. A bed of Tertiary gravel is exposed on the south bank, showing what appear to be lines of sedimentation, dipping south-east and nearly vertical. On the same bank, a little further up stream, some brown coal beds, in which a certain amount of shaft-sinking and boring was done, proved to be inclined to the south-west at the high angle of 45°. Some diamond-drill boring was also carried out in the neighbourhood. As the results obtained by this means corroborated some important facts which had already been gleaned in other directions as to the period at which the faulting of the rocks occurred, it will be worth while to describe them. A quarter of a mile west of the Railway Station the range takes a horseshoe bend, and forms a kind of amphitheatre of, it may be, 100 acres extent—drained by two small streams. The northern side of this circular depression is higher and steeper than the bounding ridge on the south. From its slopes good sections may be obtained showing Mesozoic sandstones, basalt, ferruginous conglomerates, and later-formed Tertiary clays, &c., in ascending order. A bore was put down, starting in the Mesozoic sandstones. After passing through 224 feet of these rocks, 100 feet of Tertiary clays and hard basalt were met with, the bore again passing into the sandstone at the depth of 324 feet. This clearly proved the existence of a reversed fault with a displacement of at least 224 vertical feet. The hade of this fault is apparently to the N.W. On the downthrow side in a small gully traversing the hill-slope, the basalt, conglomerate, and quartz gravel, which as before mentioned are visible in the high range, can be seen to have participated in the movement, the date of which is thus established as later than the period of the formation of the last-named deposits. The surface rocks in this neighbourhood are much concealed by loose material from the higher level of the hills; and though the evidence to be obtained is on this account not very abundant, what is available is in its nature both important and conclusive. A second bore was afterwards put down at a distance of about 400 feet from the first bore, in a north-westerly direction and at a point 180 feet higher. This bore, after getting through about 23 feet of superficial drift, intersected 180 feet of clay and basaltic formations more or less dense, and passed into Mesozoic sandstones at a depth of 200 feet. The amount of dip exhibited in the sandstone cores from this bore is as high as 35°. In a small exposure near the face of the fault the same rocks show a dip of 19° to S.S.E.

Some 4 miles further up the river basin, and near the foot of the Lydiard Range, in the banks of a small feeder named Collina Creek, we have further evidence of extensive faulting. The Mesozoic rocks are exposed in this locality in the bed of the creek and for some distance up the hill-side. They are surmounted by basalt. There is evidence of quartzite occurring here, though I have not obtained any exposure of these rocks *in situ* at this particular point. The basalt is overlaid by ferruginous conglomerates which may be traced along the hill crest at an elevation of about 1,000 feet above sea-level, and some 300 feet above the creek bed at the point under notice. The dip of the Mesozoic sandstones is here north-westerly at 25°, and it corresponds to that observable in the same rocks at Cameron's Gully, about 1 mile to the eastward. The range rises in a direction opposite to the downward inclination of the strata, and at its base, lying in contact with the Mesozoic sandstones, are some beds of ferruginous conglomerates, plastic clay, and yellow ochre, with distinct lines of sedimentation also showing an inclination to the north-west. The situation of these beds is such as might at first sight suggest a mere flanking deposit, but viewing it in connexion with all its surroundings I regard it as evidence of a powerful downthrow, having in all probability the same mode of occurrence as at Darlimurla, that is, being of the reversed kind. The country in this locality is very much broken, and the surface is concealed by an extremely rank growth of vegetation. So far as my observations in this neighbourhood have gone, they tend to convince me that this fault corresponds in direction to, and is probably an extension of, one of the series of parallel faults whose existence is indicated by the quartzites to be met with on the line from McDonald's Track to Stony Creek as already mentioned.

I shall conclude the evidences of faulting here given by another instance that occurs in the valley of the Morwell River near the junction of its tributary, the Little Morwell, and 1½ miles to the north-west of the Boolarra Coal Mine. As some important considerations are involved in the establishment of the fact of the existence of this fault as it presents itself to my mind, I shall treat the subject with some degree of detail. At this locality, and not far from the Boolarra Railway Station, a diamond-drill bore was put down, from which some interesting and valuable geological facts were obtained. After the bore had gone through various beds of brown coal, clays, and sands, 123 feet of basalt was encountered at a depth of 800 feet from the surface. Along the adjacent range which has already been described as skirting the course of the Little Morwell River, and which extends opposite the bore in question, I have traced an ascending succession of Mesozoic sandstones, basalt, and Tertiary conglomerates, and cemented sands. These latter occur at an elevation of about 200 feet above the site of the bore, and I regard the basalt with its superincumbent cemented gravels intersected by the bore as being connected with the beds now removed from them by a distance of 900 vertical feet. The evidence already given of the extensive faulting in the vicinity of the Boolarra Coal Mine at Darlimurla, and elsewhere throughout the area treated on in this paper, will have shown the strong probability of the existence of some still more powerful line of fracture of which the former are but branches. The evidence of faulting obtainable at the place under present consideration, though perhaps of not so direct a character as may be observed at some of the other localities, is nevertheless to my mind perfectly conclusive. There is no reason for supposing that the basalt met with in the bore was struck upon the edge of its western limit. Had it been traced out it would in all likelihood have been found to extend much further in the direction of the elevated face of similar rock exposed in the hill-slope. From the crest of the range, where the basalt appears in contact with its overlying conglomerates and cemented gravel, the former rock may be traced down the hill-slope for some distance, till it approaches to within half-a-mile of the bore; but there is no ground for disbelieving that the edges of the disruted beds approach much nearer than this to a vertical line extended downward from the farthest easterly point of extension in the face of the hill. In fact, such must undoubtedly be the case, unless we assume that the basalt was intersected by the bore at its western limit, or else regard it in the light of a volcanic dyke. It may be mentioned that the bore had to be abandoned owing to an accident which also prevented the last borings from being withdrawn; but prior to the accident it was evident to those in charge of the operations that a description of rocks of far less density than the basalt had been entered. In all probability these were the Mesozoic sandstones, which, as already mentioned, are to be seen underlying the basalt at various places farther up the valley.

Near the eastern side of the Darlimurla Village Reserve, about 2½ miles from the Boolarra Railway Station bore, I had obtained a vertical section which, during the progress of the bore, struck me as showing a noticeable correspondence with some of the results obtained in the latter. The points of resemblance consisted of the occurrence of some fossiliferous sandstones, represented in the section by a band of sandy clay containing impressions of similar leaves, followed in descending order by deposits of quartz gravel, stiff carbonaceous clay beds containing a stratum of a peculiar micaceous-clay, then a considerable amount of cemented gravel, and finally basalt, which though wanting in the section has its position well indicated by neighbouring outcrops on two sides. Without attaching too much significance to the points of resemblance here indicated, or assuming that it establishes with absolute certainty a geological horizon, I regard it as at least corroborating to some extent the deductions I have drawn from the data gathered in the vicinity of the Boolarra Railway Station bore. Further evidence of the same character may be adduced from the results of boring in the higher ground about a mile back from the crest of the range that extends opposite to the Boolarra Station. The bore put down in that locality was not, however, carried to any great depth, owing to some difficulty being encountered in getting through a bed of coarse gravel. This caused its abandonment when it had attained a depth of 286 feet. This bore was begun in ground about 100 feet higher than the one put down near the Boolarra Station; and far from resembling it in its results, the 139-ft. seam of brown coal and the subsequent rapid alternation of coal and clay that formed so noticeable a feature of the latter bore were here altogether wanting. I am strongly inclined to the opinion that the 286-ft. bore was confined in its operations to the belt of sands and gravels which immediately overlie the basalt, and that had it been possible to continue the boring for a short distance further this rock *in situ* would have been intersected. This opinion is justified by the position of the bore in regard to the basalt exposed in the hill face as before noted, and by the re-appearance of this rock upon the other side of the bore about a mile away. It may be noted also that basaltic boulders were present in the coarse quartz gravels that were met with about the time boring was discontinued. A similar bed of drift containing basaltic boulders, and no doubt the outcrop of that encountered in the lower part of the bore, may be seen in proximity to the basaltic sheet in the Stony Creek Valley 2½ miles distant.

In the upper portion of the Boolarra Railway Station bore, above the region where gravels and ferruginous conglomerates predominate, we have a succession of clayey and sandy deposits, interstratified with a great number of seams of brown coal, the largest of which has attained the thickness of 139 feet. Perhaps a little consideration of the conditions under which these vegetable deposits originated may help to elucidate the mode of the occurrence of the faults. There can be little doubt that the brown coal beds at Boolarra are continuous with those known to stretch beneath the wide Tertiary tract lying between that locality and Morwell, and thence continuing beyond the Latrobe River. At Morwell the deposit was found to be 496 feet in thickness, with one insignificant parting of clay; near Yinnar it was proved to be 160 feet thick, and the Boolarra bore showed the thickness to be 139 feet at that place.

If we discard the driftwood theory as inapplicable to the formation of carbonaceous beds so enormously thick, and yet free throughout from any admixture of sand or mud, and allow that the beds resulted from the rapid growth of vegetations over a vast bog-like tract, then the assumption of the gradual subsidence of the marshy area will account for the existence of the thick deposits as well as for the numerous and sudden alteration of beds of clay, sand, and vegetable matter as disclosed in the Boolarra bore. So long as the rank growth of vegetation kept pace with the descent of the area upon which it flourished, the carbonaceous material would form an ever-thickening bed; but whenever the rate of subsidence overtook that of carbonaceous accumulation and carried the surface below water-level it would favour the deposition of argillaceous material, and to a certain distance from the shore line that of sand and gravel more or less coarse.

The causes which brought about the subsidence of so large an area as the wide-spreading Tertiary plains of Central Gippsland must have affected to a powerful degree all the neighbouring territory, and would be sufficient to produce that intense state of disturbance which, as we have seen, must have prevailed in adjacent regions at some period subsequent to the basaltic overflow, and the deposition of the conglomerates and the Darlimurla brown coal beds.

Taking a general view of the area I have here treated on, and considering it with the object of showing the correlation of the lines of faulting I have described, the foregoing details may be thus summarized:—1. That the general direction of dip in the strata ranges within the limits of N.N.W. and W.N.W. on the one hand, and S.S.E. to E.S.E. on the other. The cases in which it oversteps these limits are very rare, and then only by a few degrees. 2. That the lines of faulting cross the direction of dip approximately at right angles. 3. That they are marked by valleys running in that direction and forming the drainage basins of the district. 4. That they spring from a common source, namely, the western edge of what is apparently a wide area of subsidence. 5. That the faulting occurred in later Miocene or early Pliocene times.

I may add that there is no evidence in the district of any volcanic overflow having taken place during or subsequent to the period of faulting; but, when the age of the enormous accumulations of vegetable growth in what I have assumed to be a wide area subsidence in Central Gippsland has been thoroughly established, it may be possible to regard some of the newer lava flows of the colony as being due to a contemporaneous volcanic activity.

GEOLOGICAL REPORT ON THE NORTH-EASTERN DISTRICT.*

(*By the late Norman Taylor, Geological Surveyor.*)

By instructions from the Mining Department I was authorised to make a geological survey of an area of country 108 square miles in extent; but from this a considerable area in New South Wales, north of the Murray River, had to be excised, and a portion of the Murray River flats on the Victorian side have been left unfinished, owing to their inaccessibility through floods, thus reducing the area to less than 70 square miles. The plans, eight in number, have been forwarded at intervals to the Department, and I have now the honour to submit the following report:—

The portion of the Rutherglen gold-field now geologically surveyed includes the parishes, or part of them, of Carlyle, Lilliput, Chiltern West, and Gooramadda, in the county of Bogong. This area is drained by two main channels, the Murdering Hut Creek and the Black Dog Creek; and these, together with others further south, all flow from east to west, and then almost at a right angle north to the Murray River, and parallel to one another.

The geological formations are confined to alluvial (recent), Tertiary (Pliocene), Glacial drift (Upper Palæozoic), Lower Silurian, and Metamorphic.

The Pliocene formation is represented by the widespread Murray tertiaries, through which protrude the gradually lowering northern extension of the ranges further south and south-east, forming as it were low islands and peninsulas in the Tertiary sea. The heads of the shallow gullies running from the ranges are all more or less auriferous, and were first worked about the year 1860, and the statement appended by Messrs. Harris and Briggs will give an idea of the amount of gold obtained from the worked leads about that time. The leads, gradually deepening as they got away from their sources, soon became too deep and wet to be worked profitably, and were consequently abandoned, only to be again taken up in later years by companies who were better able to cope with the difficulties of working them. Boring operations have been carried on both by the Government and by private parties, and the probable direction of some of the leads has been pretty well ascertained, but much remains yet to be done by boring before the courses of the numerous leads can be definitely determined. Mr. Mining Surveyor Arrowsmith's map of the district has been a good guide to parties taking out mining leases, as, from his long acquaintance with, and intimate knowledge of, the district, he has shown very accurately the courses of all the worked leads. Since then Mr. E. J. Dunn has mapped the district for the Mining Department; his map showing roughly the outcrops and boundaries of the Silurian bed-rock. The exact boundaries are far from easy to determine, owing to the nearly level or only slightly undulating nature of the country. They have to be looked at from many different points of view before any idea can be arrived at of the true trend of the valleys and depressions. Nothing but a connected series of surface levels and reliable bores can ultimately settle the underground configuration of this country.

As regards the leads worked in the early days, little reliable information can now be obtained, and it may be as well to quote from Mr. Arrowsmith's contributions to the late Mr. R. B. Smyth's *Gold-fields and Mineral Districts of Victoria* 1869, page 89:—"The Rutherglen gold-field, known as the Wahgunyah diggings, was discovered in September, 1860. On the 20th of that month the prospecting claim on the Wahgunyah lead was registered; on the 6th October, the Lanarkshire was proclaimed; on the 10th October, the Robbie Burns; on the 22nd October, the Hibernian; and on the 24th October, the Clydesdale. Then followed, in rapid succession, the Young Wahgunyah, Rose of Sharon, Newcastle, and Clare. During the ensuing November and December the following leads were opened:—Sailor's, Perseverance, Eureka, All England, Rose of Victoria, Garibaldi, and Great Northern. During 1861 eight more were added to the list, viz.:—The Rose and Thistle (since called Conquering Hero), Staffordshire, White Star, Union, Glamorganshire, Mona, Homeward-bound, and Tam O'Shanter. The Hibernian, Clydesdale, Newcastle, All England, Garibaldi, and Mona lie chiefly in deep wet ground. . . . The main Indigo lead was the scene of a great rush in 1858. . . . The shallow diggings were rich, but the more valuable drifts occurred in patches, and it was not until the lead was opened that the miners generally became sure of a reward for their labours. In 1859, some parties got from £8 to £9 per week per man, and very few claims paid less than £4 per week per man. From the Wahgunyah, Lanarkshire, Robert Burns, and other leads goods results have been got. About 8oz. to the load have been washed from dirt about 1 foot in thickness. The bed-rock, in many places, is from 90 to 145 feet below the surface, and the sinking generally is dry. From the Wahgunyah lead 30 loads gave 64oz.; 25 loads, 42¾oz.; and 22 loads, 36oz. 18dwt.; from the Lanarkshire lead 40 loads gave 70oz.; and from the Robert Burns 46 loads gave 100oz." (lead 200 feet deep with narrow gutter). "The washdirt, in some places, is 2½ feet in thickness, and has yielded on an average from ½oz. to 2oz. to the cart load. The Union lead, at a depth of 192 feet, showed washdirt 3 feet in thickness, which averaged 15dwt. to the load, and the Glamorganshire, at a depth of 200 feet, showed 5 feet of auriferous drift, which gave about ½oz. to the load. The Homeward-bound was found at a depth of 245 feet, and was very wet. The wash, about 4 feet in thickness, gave 1½dwt. to five small buckets. The Mona lead, with wash 18 inches thick, yielded 13½oz. to about 19 loads. The leads in this locality, numbering, perhaps, 30, are nearly all of the same character. The detritus in the gutters, derived partly from the granite and partly from the schistose areas is singularly valuable, containing as it does both oxide of tin and gold. . . . ." This latter remark can only apply to the Chiltern valley lead, which has tributaries heading in the granite areas to the south, and in which tin has been found in association with the gold. A singular exception to the non-stanniferous character of the Rutherglen leads is the Rutherglen Company's mine, in which tin oxide did occur, though from whence derived is at present unknown.

An *Argus* special reporter on the field, some time since, stated:—"Many people believe that the ancient bed of the Murray was very much further north than the present course of the river, and that, therefore, the leads will be traced not only to the Murray, but for some miles in Riverina till the ancient bed of the Murray is reached." Now, considering that these leads are from 300 to 400 feet below the present river bed, and may be 500 feet by the time they reach where the river now is, as the distance from Prentice's to the nearest point of the river is over four miles, I think the Murray River may be left out of the question. In my opinion the Murray tertiaries are here merely the margin or coast line of the ancient sea, like the Wimmera Plains, which in several localities (Stawell, Warranook, &c.) were rich in fossiliferous Pliocene marine beds, like those at Flemington and Mordialloc. These beds may eventually be found in this district, when the northern extension of the leads are better developed. The leads were probably in process of formation during the gradual upraising of the land from the Pliocene sea, when the Murray was non-existent.

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* Geological plan may be obtained at the Mining Department. Price Three shillings.

On page 151, Smyth's *Gold-fields and Mineral Districts of Victoria*, it is stated:—"In the leads at Wahgunyah fossil-wood has been found in some places, but not in great quantities. It is reported that in a well sunk in the basin towards which the leads trend" (wherever that may be) "fossil shells have been found ; and, as these leads are quite close to the Murray tertiaries, hopes were entertained that here at last we might be able to correlate the auriferous drifts with the fossiliferous tertiaries, and determine their age, but, if fossil shells were found, they cannot now be produced." The clays forwarded by Mr. Arrowsmith were said to contain the remains of *Foraminifera.*

The Murray River, where the 3-chain road running north-westerly through the parish of Carlyle touches it, is 145 feet below Rutherglen ; and the top of the Murray Tertiary beds at Smith's vineyard is about 65 feet above the river. Silurian rocks occupy the bed of the Murray River from the Wahgunyah and Corowa bridge northerly to Smith's All Saints' vineyard, thus precluding the passage of any of the leads westerly, but between that and Howlong no rock is visible in the river bed, except the irregular beds of Tertiary limestone. For over a mile south of the bridge the Silurian rocks form a range of hills, bounded on the west by the Sandy Creek, and capped in places by sandhills. These latter are characterized by a number of basin-like depressions, without any outlet. In ploughing these, loose rounded boulders of granite and other rocks were met with, evidently ice-born erratics. These sandhills are only to be found on the east side of the river along its north and south course, on the west side of the parish of Carlyle.

The prevailing red surface-soil is everywhere full of round pisolitic and concretionary ironstone, resting on sand and marly clay containing concretionary nodules and vertical lumps of an impure carbonate of lime and magnesia.* This latter crops out in considerable quantity in various places along the banks of the Murray River and the Black Dog Creek, but not in any connected beds. Shingle beds also occur, containing black and red jasperoid, and other pebbles of metamorphic rocks, which, near Quot-quotta station (on the New South Wales side of the river), have been recently found to contain payable alluvial gold. The gravel beds of Wahgunyah are of the same character, and have lately been taken up by a company. The river sand is highly micaceous.

The alluvial mines at present, or recently, working are as under :—

Prentice Freehold.
Great Northern Extended.
Great Northern.
Great Northern Extended, No. 2 shaft (Mona lead).
All Nations.
Hunter's Freehold.
Glenfern.
Indigo Stockyard or Junction.
Chiltern Valley No. 2.
Lock-out Extended—Marengo's, and Smith's.
Great Southern.
Wahgunyah (late Little Rutherglen).
Rutherglen (on the old Wahgunyah lead) were working until recently, but have suspended operations pending reconstruction.

Prentice Freehold.—Work was first started about the end of 1891. A shaft was sunk to a depth of 372 feet (bottom of well), the bed-rock being struck at 296 feet (a soft spongy reef), with 3 feet of wash overlying it, carrying a little gold, but not payable. The main level was driven at a depth of 364 feet. Its direction is north 40 feet for chamber and plat, and then N. 85° E. about 930 feet, and rising at the rate of 3 inches per 100 feet. The gutter has been proved to be 460 feet wide at the south end of the workings, and 406 feet in the main drive. Several bores were put up, and proved the lead, with 2 feet 6 inches of wash, at from 43 to 45 feet over head. The mine is comparatively dry, the water present coming from open reef crevices. It is slightly brackish. Two branch levels from the main level, going north and south, are being driven in brown sandstone with slate bars. A first dividend was paid on the 14th August, 1893, and the future prospects of the mine look exceedingly good. Mr. Wm. Manners, the manager, in his report of the 12th August, 1893, states that—" Since the opening of the rises there has been 4,709 feet of leading drives and cross-cuts driven, and about 964 square fathoms of ground panelled out ; this has given 428 machines of dirt, yielding 2,755oz. 4dwt. of gold—about 6oz. 8¾dwt. to the machine. Taking the whole mine, so far as opened up, the yield per fathom has been about 30dwt." From the soft swelling nature of the bottom (reef), and the heavy clay back over the wash, the sides and bottom of the drives close in, and cause much delay in the working.

Great Northern Extended.—This claim was first pegged out by Messrs. Hicks (sen.) and Corry, and afterwards taken up by a syndicate. The wash was reached at 280 feet. Payment of dividends commenced four years ago, since which £100,000 has been paid. The company are working two leads, the *Northern* and the *Rose and Thistle.*

Great Northern.—This mine was worked in the early days by a co-operative party of eight from three shafts. Twelve hundred feet of the gutter, from 140 to 160 feet wide, yielded 7,000oz. of gold. The fortnightly dividends of the party varied from as high as £109 to as low as 30s. per man. The third shaft, when sunk about 200 feet, was sold, with the ground, to a Ballarat syndicate, for £14,000, and has since paid dividends amounting to over £19,000. The main shaft is sunk 258 feet, and the wash was bottomed at 238 feet. At the Extended Company's boundary the gutter was 400 feet wide, but southerly it narrows to 30 feet. The main drive is in a direction of S. 7° E. 1,060 feet to jump-up, and then south 1,000 feet to the old shaft. The Mona lead comes in from the south-east, about 300 feet south of the main shaft. The gutter is worked out to the northern boundary. The workings are quite dry, being drained by the Great Northern Extended Company, but the ground swells a great deal from the floor and sides.

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* Probably formed by mineral springs.

All Nations.—This company is on the old Union lead. They hold 2,000 feet on the lead, of which 550 has been worked at the lower end, 400 feet of it giving about 1,800oz. of gold in less than two years. The wash is about 200 feet from the surface. The gold is rough and very little waterworn, and runs about 1¼dwt. to the dish. The lead is from 35 to 40 feet wide, widening in places to 70 feet. The mine is dry.

Hunter's Freehold.—The shaft is sunk 230 feet (198 feet to the bed-rock). The lead is apparently trending to the west. The shaft has been put down too near the head of the lead.

Glenfern.—Sinking and driving for lead proved by bores.

Stockyard or *Junction.*—This claim is on the continuation of the Indigo lead, and about three-quarters of a mile to the west of the old Stockyard shaft.

Chiltern Valley, No. 2.—This company has a fine plant.

Marengo's.—A private company ; no particulars.

Smith's Lock-out Extended.—A private company, and from appearances, doing well. The lead runs south-west into the Chiltern Valley lead. The shaft is 230 feet deep. Another old shaft to the north-east is 208 feet.

Great Southern.—This company have a splendid and powerful plant, erected at great cost on the supposed extension of the Indigo and Chiltern Valley leads. The main shaft was sunk 440 feet, bottom being struck at 150. Levels are being driven south-easterly at 398 feet and 434 feet respectively. The old shaft, about half-a-mile to the south-east, was unfortunately sunk on to the lead, and had to be abandoned. Several bores were put down to prove the ground; the deepest, towards which they are now driving, bottoming at 370 feet. The Indigo lead, the Homeward-bound lead, and Kelly's Freehold lead will no doubt pass through their ground. In sinking the shaft a gold-bearing reef was cut at 286 feet, and carried down nearly vertically for some distance. It was about 14 inches thick with a high westerly dip. The water-level is at about 150 feet, and the water quite fresh.

Wahgunyah.—A new plant has been erected, and they are now sinking for the lead which was last worked by the New Ballarat Company 26 years since, and whose old shaft is about 1,200 feet to the east of the new shaft. The old shaft was, according to Mr. Arrowsmith, 235 feet deep, 162 feet below the bed, and 178 feet below low-water level of the Murray.

Rutherglen.—This company have a fine plant, and were supposed to be on the old Wahgunyah lead, but the wash obtained was not payable, and curiously enough contained tin oxide, which has never been found in any of the Rutherglen leads, and must have come from the Chiltern ranges. The shaft is sunk to a depth of 346 feet (well bottom). The rock was met with at 236 feet, and a level put in at 335, and driven north-west and south-east with cross-cuts north-east and south-west. The mine water is very brackish.

A large number of new claims have been recently taken up for alluvial mining. Among them are—

Chiltern Valley G. M. Co.
Great Northern Extended Consols.
Robert Burns Extended Co.
Sun G. M. Co.
Southern Lights Co. (to follow the Glamorganshire and Perseverance leads).
Great Southern No. 1 Co.
Great Northern Junction (Rose and Thistle).
Gooramadda Proprietary Co.
North Prentice.
Prentice Consols.
Madame Prentice.
North Prentice Extended.

The White Star lead.—The old shaft is situated at Messrs. Brown and Rue's battery. It is stated to be 210 feet deep to the bed-rock, the water level being at about 70 feet. The wash rises rapidly to the east, and falls to the west. It consists of rounded sandstone boulders, with more or less semi-angular and rounded quartz. Another shaft was sunk 15 chains east of the Rutherglen Company's shaft on the 2-chain road, but no particulars are available. Some suppose that the Rose of Sharon lead on the east comes round through the gap marked on the plan to the north-east. I think that the drift above mentioned is a reef wash, and that the main gutter will probably be found under the swamp to the west ; and this gutter is, in my opinion, the probable extension of the Wahgunyah and Lanarkshire leads, here hugging the high reef on the eastern side of the valley.

UPPER PALÆOZOIC (?) GLACIAL DRIFT.

This drift consists of loose boulders of all shapes and sizes, though mostly flat and rounded, of granites of all descriptions, indurated slates and sandstones, agatiform quartz, grits, jasperoid quartz, quartzite, and large and small boulders of Upper Silurian sandstone (= Mayhill sandstone) thickly studded with casts of bivalve mollusca (*Orthis*, *Atrypa*, &c.) None of these are of local origin, and some must have come from long distances, the Upper Silurian fossil rock probably from the neighbourhood of Mount Ida, near Heathcote. Mr. E. J. Dunn observed Upper Silurian fossil casts in the Eldorado conglomerates. The deposit is nowhere to be seen in place, but only occurs apparently as loose boulders, which have been ploughed up at Taaft's, Webster's, Grondona's, &c. Further to the south, near Springhurst, these deposits are more largely developed, and cap the flanks of the Silurian hills.

SILURIAN.

The Silurian rocks (presumably Lower Silurian, in the absence of any fossil evidence) consist of course and fine-grained micaceous sandstones, grits, sandy slates, thin and laminated slates and mudstones, mostly white, yellow, or brown coloured. At Harris and Hollow's Great Eastern reef a peculiar, very tough, greenish coloured sandstone was met with in depth. The beds are much plicated and twisted, and are traversed by a most complicated arrangement of joints, as shown by the accompanying list of dips and strikes of joint planes taken in a quarry at Quarry Hill. The joint planes are often coated by manganese binoxide and thin veins of quartz, and the sandstones are intersected by nearly horizontal quartz veins.

Dips of joint faces of Lower Silurian sandstone at the Quarry Hill, south of Rutherglen:—

E. 8° S. 78°, E. 10° S. 80°, E. 15° S. 78°. (Main joints.)
N. 32° W. 61°, N. 38° W. 72°.
W. 40° S. 86°.
N. 5° E. 81°–88°. (Main joint.)
S. 46° W. 18°. (? bedding.)
N. 30° W., vertical.
S. 5° E. 35°, grits.
W. 40° N. 75°, W. 22° N. 85°.
E. 42° N. 62°.
S. 5° W. 86°.
E. 40° S., vertical.

The beds are mostly micaceous sandstones with horizontal quartz veins. The bedding is apparently nearly horizontal, with a slight dip to W. 12° N. 26°.

Dip of slates in road cutting south of Quarry Hill, W. 27° S. 33°.

Strike of joints—N. 5° E. with an easterly dip N. 35° and 30° E., beds vertical, N. 45° E. with a dip to S.E. to 46°.
N. 27° E. with a dip to N. 63° W., at 58°. N. 70° W. with a dip to N. 20° E. at 65°.
E. 8° S. to N. (Main joint.)
Others dip N. 20° E. 65° and S. 50° E. 58°.

In road cutting south of Public Park, Rutherglen:—

Dip of shales, W. 23° S. 64°, curly beds.
Joints, E. 5° S. and W. 5° N., nearly vertical; N. 32° E., dipping E. 32° S. 71°.
Do. strike E. 25° N. and N.E.

The beds are a series of small sharp folds.

In railway cutting at bridge in Rutherglen:—

Dip of slates, W. 20° S. 63°.
Joints dip, W. 8° S. 42° and W. 5° N. 30°. Thin sandy slates and coarse grits.

On the south side the beds look horizontal along the basset edges. Quartz veins numerous at the east end of the cutting.

Quarry on Burrows' Hill:—

Dip, W. 17° S. 75°.

Reefing may be said to be almost in its infancy. Until recently Messrs. Harris and Hollow's Great Eastern reef was the only one worked to any depth about the year 1880. A large number of reefs have been opened up, some being rich, but have, from some cause or another, with few exceptions, been abandoned. The so-called reefs are, as a rule, very undefined, being merely thin strings or veins of quartz running in all directions. What in many instances have been taken for walls are only joint planes. A short time since the Rose of Sharon was the only reef working, but this has now been abandoned, and the plant sold; and, at present, the Garibaldi Company, who have erected a plant, is the only one on the field. A peculiar characteristic of the district is the quantity of quartz with which all the hills are covered. All the trenching done has proved nothing but leaders, although fine examples of slickensided and laminated quartz, some of large size, are found on the surface, proving that truly defined lodes have been in existence.

The Rose of Sharon Company's shaft was sunk 184 feet to the well bottom, striking the bed-rock at 126 feet. The water level is at 110 feet, and the underlie of the reef to the west. At 171 feet a drive was put in E. 12° to 18° S., in which a reef from 3 to 6 inches thick was cut at 102 feet, striking north-westerly, and dipping W. 20° S. 57°, with a good hanging wall. This was cut out by a slide dipping N. 13° E. 42°.

The Great Eastern Company's shaft was sunk 340 feet. At about 300 feet a bluish-green dense slate was struck, passing deeper into green indurated micaceous sandstone. The water level is said to be at 170 feet. No particulars of the old workings are obtainable, but one of the original owners, and others, are carrying on some prospecting with the hope of finding the run of the old reef, which about thirteen years ago produced 9,060oz. of gold from 3,000 tons of quartz. Mr. Lord, another old resident, is also prospecting with the same object, but very indifferent success has attended their labours. The country appears to be much disturbed by slides and faults. The cap of the reef outcrops on the hill, striking N. 40° W., and dipping S.W. In some of the old surface workings, down to 60 feet, as much as from 3 to 4oz. to the ton were obtained, but a recent crushing of 13 tons only gave 6½oz. of gold. A large quantity of tailings left by Messrs. Harris and Hollow are still on the ground, and I append the following report on them by Mr. J. C. Newbery:—No. 325 (Harris and Hollow)—Assay, 5dwt. 5gr. per ton; concentrated to 6·4 per cent. of its original weight, gave 1oz. 8dwt. 23gr. of gold per ton of concentrates, or only about one-third of the gold present saved.

The Lanarkshire Reef, on which the deepest shaft is only 160 feet, has yielded gold as high as 9oz. per ton.

Reef south of Quarry Hill.—Dip W. 2° S. 36°.

Reef south-east of Quarry Hill.—Strike N. 5° to 10° E., with high easterly dip, hanging wall, apparently a joint face—nothing defined. Thin vertical quartz veins of varying thickness, slates curly and metamorphic looking.

Wee Speck Reef, on Cooper's line of reef.—This reef dipped easterly to 100 feet, and then west. It was sunk on to 160 feet, but the gold was got in spurs to 60 or 70 feet—as much as 14oz. to the load.

Campbell's Reef.—This reef has been sunk on to a depth of about 145 feet. It underlays 1 in 6 to the south-west, and strikes N. 40° W. It is much faulted by slides, throwing it to the west. The country consists of thin laminated sandy slates, grits, and sandstones. It is said that £10,000 was at one time taken out of 200 yards of the reef.

The Garibaldi Reef.—The lease was purchased from Messrs. Brown and Rue, who had taken out about 600oz. of gold previously to the sale to the company in August, 1892. The new shaft is 191 feet deep—driven south-west 31 feet to reef underlying east—driven along the reef S. 18° E. 40 feet, when a fault or slide was met with running about east and west, and dipping north.* In the old workings the reef was followed down for 177 feet. In the upper levels it was rather broken and mullocky, being a mere net-work of quartz veins, but at the depth now reached it assumes a more settled appearance, and is about 3 feet thick, and widening apparently under foot as well as going down more vertically. It cuts diagonally across the bedding planes of the country, which latter appear to dip to E. 35° N. at an angle of 43°. The reef at 177 feet strikes about N. 30° W., and dips at an angle of 70° to E. 30° N., with leaders coming in on the hanging wall. At 100 feet in depth the strike is N. 20° W., and at 60 feet it turns for a short distance to S.E. and N.W., and again resumes its former course. From this latter level it has been worked to the surface, yielding generally over 1oz. of gold per ton, and often 2oz. At 40 feet it gave 1½oz. per ton. The country consists of soft satiny slates on the east and soft sandstone on the west. It is much cut up by joints in every direction. A yield of 340oz. was obtained from 400 tons, or about 17½dwt. per ton. A curious feature is the occurrence of very fine gold in the bedding planes of the fawn-coloured sandy slates and micaceous shales enclosed between the reef and the western footwall. A similar, in fact identical, occurrence is mentioned as occurring at Kamarooka, in Smyth's *Gold-fields and Mineral Districts of Victoria*, page 233. Manganese binoxide is of common occurrence in this as in other reefs of the district.

The hill on which this reef is situated is traversed by numerous other reefs, all more or less worked, viz.:—

The Pipeclay to the west, from which as much as 6oz., 18oz., and 20oz. to the ton have been obtained.

The Red Run, to the west of the last, which was better defined, and went from 1oz. to 5oz. to the ton.

The Perseverance, to the east, dips towards the Garibaldi, and will probably come into it in depth.

The Pet of the Glen is also on the west flank of the same hill, and a crushing of 16 tons gave 8oz.

The Golden Crest Company occupy a lease to the south of the Rutherglen township, taken up by Messrs. Stewart and McDonald and Mr. Reeve. Small leaders carrying gold had been found on the crest of the hill, but, at the gravel reserve on the west fall of the hill, a large reef about 8 feet thick has been exposed. This has probably been a main source of supply to the Robert Burns lead just below it; and the owners intend thoroughly developing the property.

A reef was found in the *Golden Gate* alluvial claim, which is said to have returned 8oz. per ton.

The Maiden Reef has been put into a small company. It lies towards the heads of the Great Northern leads, and is the only one being worked in that direction. The shaft is down 180 feet. The reef strikes N. 35° W., and dips west at a high angle. The country is nearly vertical slate and sandstone. It is said to have yielded 8oz. to the ton.

It is much to be regretted that, considering the amount of gold already obtained, and yet to be obtained from the leads, so little has been done towards finding the sources from which it was derived.

METAMORPHIC.

This formation occurs at Mount Ochtertyre, just outside the north-east corner of the street. Some specimens appear to be a coarse-grained granite, while others are gneissose. No exact boundary can be traced, as the passage seems to be gradual from the Silurian rocks to the metamorphic.

APPENDIX No. 1.

EXTRACT FROM THE "RUTHERGLEN SUN" AND "CHILTERN VALLEY ADVERTISER," 30TH SEPTEMBER, 1892.

OLD YIELDS, BY MESSRS. HARRIS AND BRIGGS.

	Gold—Ounces.
Leads.	
Perseverance	12,000
Glamorganshire	300
Clare	1,700
Hibernian	35,000
Newcastle	11,000
Garibaldi	1,800
Clydesdale	26,000
Robert Burns	22,000
Lanarkshire	14,000
Wahgunyah	37,000
Young Wahgunyah	2,500
All England	40,000
Glencoe	10,000
	213,000
Reefs.	
Great Eastern (Messrs. Harris and Hollow)	10,000
Pipeclay	6,000
Baby Reef	1,000
Garibaldi	600
Campbell's	1,600
Cooper's	3,000
Total	235,500

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* This slide varies in dip at different levels from N. 5° E. 64° to N. 13° E. 63°.

APPENDIX No. 2.

HAND-AUGER BORES IN SECTION 33.—CARLYLE, 1887-8.

From *Diamond Drills and other Boring Machinery*, &c, 1889. Fourth Report, page 32.

		Feet.
No. 1.—	Stiff grey clay	24
	Grey brown sandy clay	16
	Stiff grey clay, with limestone nodules	10
	Coarse quartz sand drift	20
	Light blue clay	10
	Yellow tough clay and mica	7
	Brown sandy clay	5
	Red and brown clay	8
	Cement and quartz	2
	Red, brown, and blue clay, with pipeclay very intermixed	15
	White pipeclay reef	5
	Yellow sandstone and green schist (Silurian bed-rock)	9
	Total	131
No. 2.—	Surface soil	4
	Grey yellow clay	9
	Red, grey, and yellow clay	17
	Grey yellow sandy clay	11
	Grey sandy clay	9
	Grey jointed clay and sand	4
	Sandy clay	1
	Coarse sand or gravel	10
	Yellow brown clay	5
	Grey clay—stiff and jointed	10
	Pipeclay reef	10
	Total	90
No. 3.—	Surface soil	4
	Clay	26½
	Coarse sand	4
	Clay	5½
	Sand	8½
	Light grey clay	10½
	Cemented sand	9
	False bottom	29½
	Red brown clay	2
	Red clay	1
	Sandy clay	2
	Stiff yellow clay	7
	Drift and gravel	1½
	Blue clay and red bands	1½
	Blue and red clay	24
	Blue, red, and yellow clay, very tough and stiff	6
	Blue, red, and yellow clay—tough	33
	Blue, red, and yellow clay, with pipeclay reef	2
	Red clay and pipeclay	2
	Pipeclay reef	12
	Total	191½
No. 4.—	Surface soil and brown clay	14
	Yellow cement	1
	Green clay	6
	Cement and little clay, very hard	9
	Grey clay, with cement and gravel	22
	Limestone	1½
	Brown clay	10
	Brown cement and clay	6½
	Brown clay and limestone nodules	8
	Blue clay and limestone nodules	7
	Blue and yellow clay, with a little grit and limestone nodules	22
	Blue and yellow clay, with red streaks	8
	Red and blue clay, with grit	9
	Blue, red, and yellow clay, with grit	14
	Quartz gravel and limestone pebbles	2
	Quartz gravel	1½
	Hard yellow sandstone (boulder)	0½
	Yellow pipeclay	12
	Pipeclay reef (Silurian bed-rock)	6
	Hard Silurian schist	5
	Total	165
No. 5.—	Surface and yellow clay	14
	Yellow sand and grit	2
	Grey cemented grit	24
	Coarse sand and grit	8
	Brown clay	2
	Cement with grit and lime balls	16
	Cement and coarse sandy grit and little clay	14
	Grey clay and grit	5
	Yellow clay	22
	Pipeclay (false bottom)	17
	Pipeclay and quartz	4
	Yellow and white pipeclay	34
	Hard yellow sandstone and slate (Silurian bed-rock)	6
	Total	168

PARTICULARS OF BORES.

Rutherglen Company (Lanky's), three-quarters of a mile west of shaft.

		Feet.
No. 1.—	Surface clay	23
	Brown sand	8
	Greenish clay	14
	Brown sand	3
	Greenish clay	27
	Brown and white clay	13
	Coarse brown sand	2
	Clay and brown sand	10
	Greenish clay	11
	Brown drift	62
	Variegated clay	52
	White reef	6
	Pink reef	8½
	No wash...	—
	Total	239½

No. 2 was bottomed at 236 feet, but continued to a depth of 249½ feet. Bed-rock soft and clayey.

No. 3 was bottomed at 231 feet on well-defined bed-rock, and continued to 235½ feet.

No. 4 was bottomed at 256 feet on mullocky clayey reef—was supposed to have bottomed at 226 feet.

Bores Nos. 2, 3, and 4 were all of similar character to No. 1.

Particulars of six bores in the north and south road, crossing the railway at the Rutherglen Company's Mine, will be found in Annual Report of the Secretary for Mines for the year 1890, page 91.

Particulars of seven bores on No. 1 line, on the 150-link road, running east past the Great Southern Company's Mine—Homeward Bound lead—will be found in Annual Report, Secretary for Mines, for the year 1889, page 82, and in Annual Report, Secretary for Mines, for the year 1890, pages 90 and 91. Also, of four bores on No. 2 line, on the 100-link road, running easterly about 1½ miles north of the last, same reports and pages; and No. 5 bore, on No. 2 line in Annual Report for the year 1891, page 87.

The depths of some of a series of seven bores at Glenfern, in the parish of Chiltern West, are given in Annual Report for the year 1892, page 62. The following are the particulars:—

Glenfern Company's bores—

		Feet.
No. 1.—	Surface soil and clay	1½
	Gravelly clay, various colours	141½
	Red gravelly clay	98
	Quartz wash, colours of gold	2
	Decomposed Silurian schist, bed-rock	4
	Total	247
No. 2.—	Surface soil and clay	1½
	Gravelly clays, various colours	137½
	Red gravelly clay	58
	Sandy wash	1
	Decomposed Silurian bed-rock	7
	Total	205
No. 3.—	Surface soil and clay	1½
	Gravelly clays, various colours	122½
	Silurian bed-rock, decomposed	8½
	Total	132½
No. 4.—	Surface soil and clay	1½
	Gravelly clays, various colours	81½
	Hard sandy loam	42
	Fine gravel wash	2
	Decomposed Silurian schist, bed-rock	8·8
	Total	135·8
No. 5.—	Surface soil and clay	1½
	Gravelly clays, various colours	47½
	Decomposed Silurian schist, bed-rock	6·8
	Total	55·8
No. 6.—	Surface and clay	16
	Hard clay and gravel	7
	Very hard clay	94
	Clay	123
	Fine sand and gravel	5
	Reef	4
	Total	249
No. 7.—	Surface clay and gravel	160
	False bottom	2
	Sand and gravel	9
	Clay or mullock reef	21
	Reef	5½
	Total	197½

APPENDIX No. 3.

RAINFALL AT MR. O'GRADY'S "ROCKBARTON" VINEYARD, RUTHERGLEN, FROM JUNE, 1892, TO AUGUST, 1893.

1892.	Inches.
June 1 to 14	—
„ 15	·06
„ 16	·36
„ 17	·21
„ 18	·02
„ 19	—
„ 20	·04
„ 21	—
„ 22	·35
„ 23 to 30	—
Total	1·04
July 1 to 2	—
„ 3	·10
„ 4 and 5	—
„ 6	1·18
„ 7	·14
„ 8 to 15	—
„ 16	·33
„ 17 to 26	—
„ 27	·37
„ 28	·12
„ 29	—
„ 30	·02
„ 31	—
Total	2·26
Aug. 1	·07
„ 2 to 7	—
„ 8	·33
„ 9	·40
„ 10 and 11	—
„ 12	·06
„ 13	·42
„ 14	·04
„ 15 to 20	—
„ 21	1·28
„ 22	·49
„ 23 to 25	—
„ 26	·20
„ 27	—
„ 28	·36
„ 29 to 31	—
Total	3·65
Sept. 1 to 4	—
„ 5	·72
„ 6	·25
„ 7 to 14	—
„ 15	·58
„ 16	·16
„ 17	·19
„ 18	—
„ 19	·50
„ 20	·54
„ 21 to 25	—
„ 26	·06
„ 27 to 30	—
Total	3·00
Oct. 1 to 8	—
„ 9	·15
„ 10	—
„ 11	·16
„ 12	—
„ 13	·13
„ 14 and 15	—
„ 16	·75
„ 17	·02
„ 18 to 25	—
„ 26 and 27	·47
„ 28 to 31	—
Total	1·68

1892.	Inches.
Nov. 1	·20
„ 2 and 3	—
„ 4	·08
„ 5	·33
„ 6 to 8	—
„ 9	1·33
„ 10 to 19	—
„ 20	·46
„ 21	—
„ 22	·10
„ 23 to 30	—
Total	2·50
Dec. 1	·03
„ 2 to 6	—
„ 7	·27
„ 8 to 10	—
„ 11	·23
„ 12	·07
„ 13	—
„ 14	·14
„ 15	—
„ 16	·04
„ 17 to 31	—
Total	·78
1893.	
Jan. 1 to 18	—
„ 19	·06
„ 20 to 31	—
Total	·06
Feb. 1 to 28	—
March 1 to 4	—
„ 5.	1·51
„ 6 to 30	—
„ 31	1·19
Total	2·70
April 1	·29
„ 2 to 6	—
„ 7	·05
„ 8 to 15	—
„ 16	·46
„ 17 to 21	—
„ 22	·02
„ 23 and 24	—
„ 25	·66
„ 26 to 30	—
Total	1·48
May 1	·43
„ 2 to 4	—
„ 5	·09
„ 6	—
„ 7	·01
„ 8 and 9	—
„ 10	·62
„ 11	—
„ 12	·08
„ 13	·02
„ 14 to 19	—
„ 20	·03
„ 21	·05
„ 22 to 26	—
„ 27	1·55
„ 28	1·12
„ 29	1·17
„ 30	·01
„ 31	·48
Total	5·66

1893.	Inches.
June 1	·03
„ 2 to 11	—
„ 12	·12
„ 13	·59
„ 14	—
„ 15	·35
„ 16	·34
„ 17	·03
„ 18	·01
„ 19	—
„ 20	·11
„ 21	·02
„ 22	·04
„ 23	·01
„ 24 to 26	—
„ 27	·33
„ 28	·09
„ 29	·19
„ 30	—
Total	2·26
July 1 to 8	—
„ 9	·03
„ 10	·02
„ 11	·05
„ 12	—
„ 13	·20
„ 14	·56
„ 15	·11
„ 16	·03
„ 17	·07
„ 18	·21
„ 19	·25
„ 20	·06
„ 21	·37
„ 22	—
„ 23	·10
„ 24 to 31	—
Total	2·06
Aug. 1	—
„ 2	·54
„ 3	—
„ 4	·45
„ 5	·11
„ 6 to 12	—

YEAR'S RAINFALL.

1892.	Inches
June	1·04
July	2·26
August	3·65
September	3·00
October	1·68
November	2·50
December	·78
1893.	
January	·06
February	—
March	2·70
April	1·48
May	5·66
Total	24·81

AT MESSRS. GRAHAM BROS.' "NETHERBY" VINEYARD—FIRST FIVE MONTHS OF 1893.

	Inches.
January	·05
February	—
March	3·13
April	·88
May	5·06*

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* Of which 3·91 fell between the 27th May and 1st June.

REPORT ON THE REEFS AT TWIST'S CREEK, NEAR YACKANDANDAH.

(*By R. A. F. Murray, F.G.S., Government Geologist.*)

I have the honour to submit a report with respect to the reefs of Twist's Creek, near Yackandandah, of which I made an inspection last week. The portion of the belt of reefs examined is about 2 miles in length, and crosses the range forming the watershed between Wooragee and Twist's Creek. All these reefs were worked in former times with good results, but for a long period have been neglected. Attention is again being directed to them in consequence of the good results lately obtained from the Sydney Reef, at the northern extremity of the belt. This reef is the only one I was able to examine properly, as resumed active operations have not proceeded far as yet on the others, though the old workings along them show that they must have been remunerative.

The stated cause of abandonment, and to all appearance the true one, was the diminution in the yield of gold, owing to the stone becoming more highly mineralized with depth, and the absence of proper appliances for saving and treating the pyrites, in which a large proportion of the gold is doubtless locked up.

The Sydney Reef may be taken as a type of the reefs on this belt. The surface workings extend at intervals over a length of about 700 yards, crossing the spurs sloping towards Wooragee, and there are several shafts, one of which is said to be 100 and the other 150 feet deep, on portions known respectively as the Mountaineer and Rose of Australia. The present workings on the Sydney Reef consist of a tunnel driven 550 feet to the reef, which has been opened on for about 250 feet in length, the tunnel level being 170 feet below surface. The reef is remarkably regular and persistent, with clean well-defined walls, from 3 inches to 18 inches apart, averaging about a foot.

This great regularity and cleanness of the walls is visible in the surface stopes, and there is no cause for doubt as to the downward permanence of the lode. The stopes below the tunnel level show the same regular persistence. The bearing of the lode is magnetic north and south, the underlay being nearly vertical with slight variation of a few degrees, sometimes to the east, sometimes to the west. The stone is of excellent appearance, with visible gold and a good deal of mineral.

Among returns quoted from the Sydney tunnel and shaft is stated a yield of 382oz. 3dwt. from 342½ tons.

The Adelaide Reef, about 200 feet from the Sydney Reef, is small, but is stated to have yielded 4 ozs. per ton. Another reef, known as the Orion, about half-a-mile west from the Sydney, is stated to have recently yielded 16 dwts. per ton for a crushing of 240 tons.

The following are notes of information obtained with respect to various reefs southward along the belt, of which I could only see the old surface workings, but which evidently must have at one time yielded satisfactory returns:—

The Polar Star Reef, on range between Wooragee and Twist's Creek. Not at present working, except that mullock is being crushed, yielding 6 dwts. of gold per ton.

The Excelsior Reef.—Shaft 350 feet deep; shoot of stone described as about 60 feet long, and from 1 to 4 feet thick. There appears to be some difference of opinion as to the accuracy of the report that at bottom of shaft the shoot was left 90 feet long, 3 feet thick, and worth 3 ozs. of gold per ton. Yields up to 9 ozs. per ton, it is stated, were obtained from the upper portions, the total quotation being 2,991oz. 14dwt. from 1,143¼ tons. The reef is thrown by successive slides to the eastward. This is apparently on the same line as the Sydney Reef.

The Nonpareil Reef, on eastern slope of the range, and eastward of the Excelsior. Tunnel 300 feet along reef at level 200 feet below the surface outcrop. Reef under foot described as large, but poor. Worked to 150 feet below surface, thickness 18 to 24 inches; 758 tons yielded 588 ozs.

A small rich leader to the eastward was worked by "dollying" to about 8 feet from surface for 100 feet in length.

The Milkman's Reef.—On same range, further south, worked to 250 feet deep; shoot under 200 feet long at bottom, averaging about 6 inches in thickness; 208 tons yielded 262 ozs. Good-looking stone, laminated and mineralized.

The Duke of Edinburgh Reef, supposed to be the same line as the Excelsior, east of Milkman's. Small reef, about 6 inches thick.

The Wallace Reef.—Worked to 160 or 180 feet; further south, but supposed to be eastward of Milkman's Reef.

The Sons of Freedom Reef.—East of Wallace, and supposed to be same line as the Duke of Edinburgh, but further south. Said to be fair-sized reef; 318 tons yielded 205 ozs.

Big Tunnel.—About 200 feet east of the Sons of Freedom; worked from tunnel level; 8 feet wide for 200 feet; ½-oz. stone.

Little Tunnel.—Eastward of Big Tunnel; tunnel 1,300 feet into reef from east. Line proved 250 feet on surface; worked 30 feet below tunnel, 1½-oz. stone, but water heavy. Total stated yield, 1,907 ozs. from 2,181 tons. There are on this line two reefs, known as the east and west reefs, about 4 feet apart, said to be approaching one another downwards—the eastern one 18 inches and the western 10 to 12 inches in thickness.

The Iron Hand Reef.—Eastward of the Little Tunnel; is reported to have yielded well.

The Scandinavian Reef.—Supposed same line as Polar Star. Worked to 150 to 200 feet; abandoned, owing to excessive water and small engine power. Reef 18 inches thick. Quoted yields, 1,288 ozs. from 1,557 tons during the years 1865–77 and 1882–3.

The Homeward Bound Reef.—Supposed same line as Excelsior and Sydney Reefs; also the Victoria Hill, the same line as the Homeward Bound. Very rich patch, once obtained £900 worth of gold from two bags of stone. The Homeward Bound shaft is 220 feet deep, and there are two reefs, 17 feet apart. Good payable stone worth 25 dwts. per ton is stated to have been left at bottom of workings. Stone highly mineralized.

The Danish and Never-Can-Tell (*Fanny Elizabeth*) *Lines.*—Never-Can-Tell worked to 100 feet, averaging 10 to 12 inches thick. Danish worked to tunnel level, 250 feet below outcrop; small reef, but always good and regular. From this and the Birthday, on same line, 799 tons yielded 903 ozs.

The Pride and Stringer's.—Two reefs close together, near Back Creek; are also described as having yielded well. A tunnel is now being driven to intersect them, and has reached a very large reef 10 feet thick, poorly auriferous, but it is not certain whether this is one of the reefs sought for, and further driving will be necessary to prove it.

The above mentioned constitute only a portion of the numerous reefs that have been worked on this field. Their history, added to what I was able to see, justifies the opinion that if again worked in a proper and economical manner they will prove remunerative, especially if appliances be provided to concentrate and save the mineral for special treatment. Without anticipating results of a startling character, the field is likely to be steadily payable, and there is no reason against the belief that the reefs will continue to great depths.

NOTES ON QUARTER-SHEET No 80, N.W.—PARISHES OF DARGILE, HEATHCOTE, COSTERFIELD, AND KNOWSLEY.

(*By Ernest Lidgey, Assistant Geological Surveyor.*)

This quarter-sheet, having an area of 54 square miles, includes the parish of Dargile and portions of the parishes of Costerfield, Knowsley East, and Heathcote.

The geological formations occurring within the area and their order of sequence are as follows:—

Alluvial.—Deposits of earth, loam, sand, and gravel in beds of gullies and flats bordering creeks.
Newer Pliocene.—Sand, clay, gravel, and conglomerate.
Mesozoic.—Sandstone, and glacial conglomerate, and erratic blocks.
Upper Silurian.—Sandstones, slates, shales, quartzites, conglomerates, &c.
Lower Silurian.—Sandstones, slates, shales, &c.
Metamorphic (? *Pre-silurian*).—Basic, amygdaloidal, and schistose beds, jasper, &c.

METAMORPHIC.

The rocks provisionally coloured on this quarter-sheet as metamorphic have been classed so by the the late Mr. Norman Taylor, but Mr. E. J. Dunn considers them to be Pre-silurian.

They appear as two narrow strips having an area of about 3 square miles, and another small outcrop occurs to the west of these in a portion of block 60, parish of Knowsley East, shown on the lithographic parish plans as M of W. E. Tranter.

These rocks consist of basic lavas, amygdaloidal rocks, tuffs, agglomerates, varieties of jasper, cherty rocks, and talcose and chloritic schists, much contorted and faulted.

The rocks exposed in the smallest outcrop consist of decomposed basic lavas, traversed by vitreous quartz veins, the matrix of the rock near the surface being mostly decomposed to a rich chocolate soil leaving the quartz scattered through the soil as boulders and angular drusy pebbles. This soil is stated to have produced excellent crops of wheat.

A very good exposure may be seen on the Sheep-station Creek at a place called the Ladies' Pass, about 3 miles from Mount Camel station (14B Dargile). The creek here flows through a narrow pass, the hills on both sides sloping rather steeply. Sketch section No. 1 attached is taken from the hill on the northern side of the creek, and shows the amount of contortion to which these rocks have been subjected. These beds are very fine-grained altered slates or mudstones, very brittle, with a sub-conchoidal fracture. Some of these beds are very prettily covered with pink spots and lines. The beds here exposed are all thin bedded, in some cases as thin as paper, whilst none appear to be more than a few inches thick.

A few chains to the west of the pass some good sections are exposed of talcose and chlorite schists. These schists are much contorted and appear to have undergone extreme pressure. Many quartz veins and leaders traverse them; the quartz being a tough vitreous variety, containing chlorite in some places.

In other sections the schists contain very little free silica, but a much greater quantity of magnesia; magnesite occurring as a decomposition product in veins, nodules, and concretions. (See Section No. 2.)

A very good exposure of basic rock may be seen outcropping in the paddock opposite the Junction Hotel; also in lot 8, section A, Dargile. In the latter the rock has weathered into immense tors, having very much the appearance of granite from a distance.

Varieties of jasper may be seen to the west and north of the Ladies' Pass and at the foot of Sheoak Hill.

A good section of various coloured schists is exposed in a cutting on the Murray-road. This is the only cutting in the road in this area.

Section No. 3 gives a very good idea of the variety of schists, all of which are more or less decomposed. It also shows an anticlinal axis and four faults which occur here. This class of rock generally decomposes into a heavy reddish-brown or chocolate soil.

Selwynite and talcosite occur in a reef at the junction of the Top Forest and Murray roads at the western side of the foot of Mount Ida.

These rocks have already been reported on by Mr. E. J. Dunn, who classes them as Pre-silurian.

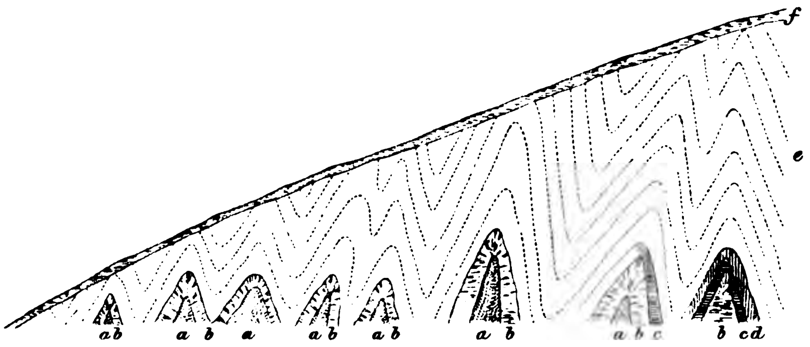
LOWER SILURIAN.

A strip of Lower Silurian rocks occupy rather less than one-fourth of the area mapped in this quarter-sheet, lying to the west of the Mount Ida Range overlying the metamorphic rocks, and being covered on the west by glacial conglomerate (Mesozoic).

N^o. I

Sketch Section of Hill at Ladies' pass, Dargile.

Scale, 40 Feet to One Inch



a. Pink Cherty beds

b. Finely laminated black and white cherty beds.

c. Laminated Cherty beds

d. Cherty beds silver grey to dull yellow.

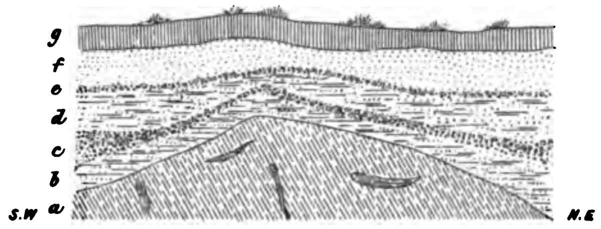
e. Beds not sufficiently exposed to obtain measurements

f. Soil

Nº 2

Section on Sheep-station Creek

Scale, 80 Feet to One Inch.



a *Decomposed greenish grey (probably) pre-Silurian schists containing nodules and concretions of impure Carbonate of Magnesia.*

b *Clay (alluvial)*

c *Gravel.*

d *Clay.*

e *Gravel.*

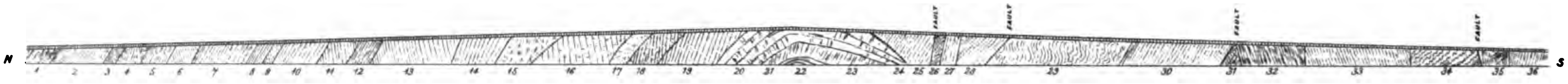
f *Clay and Sand.*

g *Soil (sandy.)*

Nº 3

Section at Cutting on Murray Road

Scale 76 Feet to an Inch.



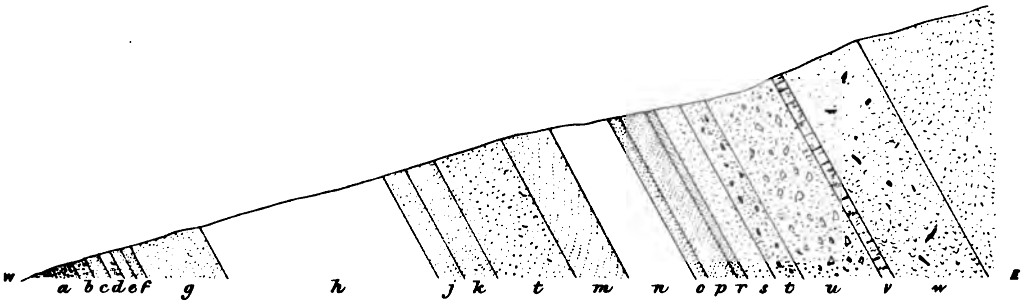
NOTE. The Road slopes from N to S at an angle of 10°.

Nº 4

Section on Gully in Block 4, Section A, Parish of Dargile.

(Mount Ida Range)

Scale, 8 Feet to One Inch.



a	Coarse Sandstone, all grains waterworn.
b	Finer Sandstone, all grains waterworn, with rounded pebbles.
c	Fine micaceous Sandstone slightly ferruginous.
d	Quartzite.
e	Fine fissile ferruginous Sandstone
f	Coarse soft white Sandstone.
g	Highly ferruginous Sandstone.
h	Rock here unexposed.
j	Slightly ferruginous soft Sandstone.
k	Slightly ferruginous hard Sandstone.
l	Decomposed soft Sandstone.
m	Slightly ferruginous Sandstone.
n	Rock unexposed.
o	Gritty sandstone in layers.
p	Fine ferruginous Sandstone
r	Soft fine Sandstone grains rounded and not well cemented.
s	Soft coarse Sandstone grains rounded and not well cemented.
t	Soft ferruginous Conglomerate containing pebbles of Quartzite, Sandstone and Clay.
u	Hard coarse ferruginous Conglomerate.
v	White Quartzite.
w	Fine Sandstone slightly decomposed containing particles of clay.

[illegible]

These rocks consist of sandstones, coarse, medium, and fine, merging into mudstones plain and micaceous; micaceous mudstones containing casts of trilobites; fissile yellow shales; and yellow and grey contorted laminated shales.

The general strike of these beds is from north and south to north 30° west and south 30° east, in fairly regular parallel beds, showing very little trace of contortion.

Several good exposures of these rocks occur in the bed of the McIvor Creek.

Another rather better exposure is a railway cutting to the east of the Derrinal Railway Station, in which may be seen 36 beds of Lower Silurian rocks underlying the glacial conglomerate, which again is covered by a thin bed of Newer Pliocene gravel.

Most of the beds of sandstone in this formation contain innumerable fine quartz veins, giving to the slopes of some of the hills the appearance of being covered by snow.

Several quartz reefs occur and are shown on the plan, but in no case was a colour of gold obtained from any of them.

Fine micaceous mudstones containing casts of trilobites were obtained from a paddock marked 3N, T. Blake, on the lithographic parish plan of Knowsley East. There is no actual rock exposure here, the specimens being obtained from stones brought to the surface during ploughing.

These rocks decompose into a sandy rather barren soil, which is of very little use for grass or crops, but should grow vines and other fruit trees well.

UPPER SILURIAN.

Rather more than half the area mapped consists of Upper Silurian rocks; Mount Ida Range forming the western boundary of the formation. Unfortunately there is no exposure or cutting showing the junction of either the Upper and Lower Silurian or the Metamorphic and Upper Silurian.

The Mount Ida Range is the most noticeable feature in this formation. The lowest beds consisting of siliceous breccias, conglomerates, and breccia-conglomerates. The same beds varying from one to the other within a very short distance. In some cases the rock is composed of a highly siliceous matrix, enclosing pebbles of Metamorphic and Lower Silurian rocks, chalcedony, jasper, &c., but in no case noticed does the conglomerate contain any pebbles of Upper Silurian rocks.

A very fair section may be seen exposed in a gully in block 4, section A, parish of Dargile, section No. 4. The lowest beds being a coarse sandstone, not very well cemented, and all the enclosed grains being well water-worn. The upper beds become finer and harder, the fourth being a hard tough quartzite.

The summit of Mount Ida and the cap of the range consisted of very hard quartzite, being in some places 150 feet thick, containing numerous fossil casts of encrinite stems. It is to this hard band that Mount Ida owes its existence as a prominent feature in the landscape.

Eastward from the Mount Ida Range the rocks become much softer, and are in many cases traversed by quartz reefs, some of which are auriferous. The country rock being hard and soft ferruginous sandstones, siliceous sandstones, soft mudstones, and soft yellow and gray shales.

The rocks at the south-east corner of the sheet in the parish of Costerfield vary slightly from the remainder, in that they consist of fine gray argillaceous beds, having sub-conchoidal fracture at the surface but changing to a hard blue slate below water-level, which occurs here at about 60 feet from the surface. The quartz reefs traversing this class of country usually contains antimony sulphide and antimony oxide.

The general strike of the Upper Silurian rocks in this area, when not faulted and heaved, is nearly north and south. A remarkable change in the direction of the strike is to be noticed on Mount Ida. In traversing the ridge of the range from north to south up to a distance of about 20 chains from the Trig. Station, the strike is slightly to the west of south, but here a change occurs, the whole mount having been twisted to the west until at the Trig. Station the strike is W. 5° N. and E. 5° S.

At about 3 miles south from Mount Ida an outcrop of granite is exposed, which probably explains the reason of the alteration in the strike of the rocks on the mount. The quartzite forming the summit, although 150 feet thick, seems to be very little faulted or broken but simply bent and curved.

The rocks to the east of the Mount Ida Range are much faulted and broken, the strike suddenly changing in a most unexpected manner from north and south, sometimes to east and west. Many quartz reefs occur in this portion of the district, the principal of which are shown on the plan. The reefs mostly strike in the same direction as the country rock, but as a rule underlie across the dip of the rock.

NEWER CARBONIFEROUS OR TRIASSIC.

This formation is represented in this district by a portion of the Wild Duck Creek glacial conglomerates, resting on Lower Silurian rocks. These have already been fully reported on by Mr. E. J. Dunn.

This conglomerate is here composed of a softish blue clay matrix, containing worn and striated pebbles of quartz of various colours, mostly of a vitreous lustre, with a few broken and crushed crystals; quartzites, plain and banded, mostly highly polished; jasper in red, brown, and yellow, plain and banded; porphyries of several colours; amygdaloidal rocks, the amygdules in some cases being hard, of red, brown, yellow, white, or of greyish colour, and in other specimens decomposed to a reddish earthly substance; lydianite; conglomerates and breccias, mostly siliceous; sandstones generally hard, tough, and compact, the softer ones having been crushed or decomposed; granitic rocks of various colours and texture; gneiss; agates, as a rule crushed and much flawed; chalcedony and chalcedonic quartz; hæmatite and limonite; chloritic quartz; basaltic pebbles; and pieces of pumice.

A fine yellow sandstone occurs interbedded with the glacial conglomerate, of which a good exposure may be seen near the McIvor Creek to the south-west corner of block 7, parish of Knowsley East. This sandstone is exposed here for a thickness of 50 feet.

Many erratic blocks are to be noticed, the largest of which are marked on the sketch map with a red cross.

Any one visiting this district should not omit to call on Mr. Hollingsworth, who resides about half-a-mile from Derrinal Station, and who has collected an immense variety of pebbles from the glacial conglomerate.

NEWER PLIOCENE.

Overlying the older rocks are to be noticed several deposits and cappings of much more recent date, which from their general character have been classed as Newer Pliocene, but there is no means of fixing their exact age.

One of these deposits occurs in blocks 24C and 24D, parish of Knowsley East, and is evidently composed of the denudation of Upper Silurian rocks. It is a ferruginous siliceous conglomerate, many of the pebbles having originally formed portion of an older conglomerate, the remainder being water-worn pebbles of quartz and sandstone. This capping is evidently very thin, and overlies Lower Silurian shales and sandstones and metamorphosed basic rocks. The junction between the metamorphic and Lower Silurian rocks passing under. A Mr. Lewis, who owns the property to the north of here, states the conglomerate has been tested, and found to contain gold in small quantities but not payable.

Another capping occurs in a portion of blocks 3F, 3G, 3H, and 3N, parish of Knowsley East, covering the summit of a hill, and extending down the sides, covering an oval space about 15 chains by 12. This capping contains pebbles of siliceous and ferruginous conglomerate and quartz (but no sandstone pebbles), mostly well water-worn, with a few sub-angular and angular ones. This capping rests on metamorphic (? Pre-silurian) schists and tuffs.

Another Pliocene deposit is to be found in block 18, parish of Dargile, resting on the basset edges of Upper Silurian sandstones, shales, and quartzites. This capping consists of a hard ferruginous conglomerate, containing pebbles of quartz, sandstone, and quartzite, all more or less water-worn. Some of the pebbles show casts of encrinite stems. This conglomerate has evidently been derived from the contiguous Upper Silurian rocks, there being no pebbles of either metamorphic or Lower Silurian rocks contained in it. This conglomerate in some places merges into a brittle ferruginous grit, containing coarse quartz sand, very similar in appearance to some of the Flemington beds. This again changes to a fine hard ferruginous sandstone, containing a great deal of fossil wood of a coarse loose texture ; in some places the wood has entirely decomposed, leaving a hollow cast or mould, showing the external structure of the piece which once filled the cavity.

In the south-west corner of the area mapped a portion of the glacial conglomerate has been re-arranged by the action of water, and now forms Newer Pliocene gravel beds. This gravel also contains many pebbles, resulting from the denudation of the Lower and Upper Silurian rocks lying to the east.

In the south-central portion of the sheet, in the parish of Heathcote, occurs another area of slightly ferruginous clays, sand, and gravel. This also has been classed as Newer Pliocene.

ALLUVIAL.

The alluvial beds are those comprising the flats bordering the creeks, or occupying the beds of gullies. These consist of the denudation of adjoining rocks, and of material brought down during heavy rains and floods, and are composed of clay, loam, sand, and gravel.

GOLD,

Several reefs have been worked for gold in this district, but in no case has the work been carried out in a systematic manner.

Creely's Reef to the north of Costerfield was sunk on to a depth of some 50 or 60 feet, and a few tons of stone crushed which varied from 1¼ ounces to the ton to a few pennyweights.

Bianchi's Reef still further north has also been worked.

The True Blue to the west of Costerfield also turned out a fair quantity of gold down to the water-level, when work was discontinued.

Stringy Bark Reef, in Knowsley East, to the west of the Junction Hôtel, is stated to have produced a small quantity of gold, but unfortunately no reliable particulars can be obtained.

Colours of gold may be obtained in the alluvial in nearly all the gullies in the Upper Silurian area, to the east of the Mount Ida Range, but rarely in payable quantities. Damper and Shell-back Gullies have probably been the best, whilst a good deal of gold was obtained from Creely's and Donelly's Gullies. No work is now going on.

ANTIMONY.

The principal antimony mines are to the east of the area mapped, but a reef has been discovered to the west of Costerfield, and named the West Costerfield Reef, from which an assay, by Mr. Cosmo Newbery, gave a return equal to 26 per cent. of antimony, and 1oz. 12dwt. 16gr. of gold per ton of ore. A shaft has been sunk on this reef.

Section of cutting on Murray-road, in Pre-silurian strata—

1. Decomposed chocolate schist
2. Yellowish-green schist
3. Chocolate schist
4. Yellowish schist
5. Light chocolate schist
6. Pale-green schist
7. Yellow schist
8. Grey schist
9. Yellowish-green schist
10. Brown schist
11. Greenish schist
12. Chocolate schist
13. Brownish-green schist
14. Yellow schist

All slightly decomposed.

15. Decomposed chocolate schist.
16. Hard brown schist.
17. Decomposed yellow schist.
18. Light-brown mottled schist.
19. Soft light-brown spotted schist.

20, 24. Hard grey spotted schist.
21, 23. Light-brown tough schist.
22. Hard grey schistose rock.
25. Chocolate schist.
26. Green schist, highly contorted.
27. Spotted-grey schist.
28. Yellowish-brown spotted schist.
29. Mottled-grey schist, highly contorted.
30. Mottled-grey schist, laminæ even, not contorted.
31. Silver-grey schist.
32. Yellow schist.
33. Mottled-greenish schist.
34. Yellow schist.
35. Dark-brown schist.
36. Decomposed greenish-grey schist.

REPORT ON THE CORRYONG GOLD-FIELD.

(*By R. A. F. Murray, F.G.S., Government Geologist.*)

I have the honour herewith to submit my report upon the quartz reefing field recently opened near Corryong.

The locality is the western slope of the Mount Elliot Range, about 8 miles due east of Corryong, and the principal line of reef has been traced at short intervals for a length of about 2 miles in the direction of the Towong Gap. The prevailing rocks are mica schists, slaty schists, and occasional bands of hard sandstone, and are metamorphic in character, with fairly even and regular bedding. Occasional large patchy outcrops of somewhat unpromising looking quartz are visible, but these do not as yet appear to have yielded any gold.

The main line of reef has a generally north and south bearing—varying from north by west to north by east—and the underlay is eastward at from 55° to nearly vertical in rate of inclination. The thickness varies from a few inches to slightly over 2 feet, though from 9 to 12 inches would be the average.

The lode-stuff is in some parts all quartz, and in others a mixture of mullock and quartz veins, but throughout the walls are well defined and coincident with the bedding of the country rock.

The above are the leading characteristics from Fenby's Reward claim—the southernmost yet on gold—through the Golden Cross, Gay's Currajong claim, and the Sheoak down to Walton and party's claim, known as the "Bread and Sugar." Here a hard granitic dyke forms the footwall, and in Hill and party's Evening Star, to the north, this dyke is visible coming upwards through the country rock from the west, meeting the lode which intersects it, and then re-appearing at the surface to the east as though the lode had been formed on a line of fault, cutting and displacing the dyke. The quartz veins in the dyke where it forms the wall of the lode are said to be auriferous, and the stuff was taken along with the lode for a recent highly payable crushing obtained from Hill and party's claim.

Walton and party cleaned up from a crushing stated at 37 tons for the highly satisfactory yield of nearly 7 ozs. per ton at the time of my visit.

In Eade and party's ground, to the north of Hill's, the lode appears to split into two, which gradually diverge. The western branch, on which is Post's claim (the prospecting claim), shows in the workings a thickness of over 2 feet in places, and bears north-north-westerly; and on the eastern branch is Murant and party's claim, in which the lode is from a mere "track," or a few inches, up to 2 feet in thickness.

The continuations of these lodes have been proved in various claims further northward, and there are also several more or less parallel lines of reef of similar character which have been opened to the eastward. On the main line, however, at least 2 miles in length has been proved gold bearing, and in places very rich at fairly short intervals, many intermediate portions being as yet untested.

Although, as may be seen, the lode is small as regards thickness, it is very persistent longitudinally, and coincides with the bedding of the containing strata in strike and underlay.

Another feature worthy of notice is that some of the various rich returns obtained have been from the high spurs, whilst others have been taken from several hundred feet lower elevation, down in the gullies. This may be regarded as good evidence of downward persistence and an encouragement to follow the lode by sinking. All the country southward towards the alluvial workings on Thougla Creek is of a promising character, and I was shown some very good specimens stated to have been found in "loaming" in that direction.

Owing to the character of the lodes, and in many cases the depth of surface rubble, the work of prospecting may be difficult and tedious, but nevertheless the country offers great inducements for close and exhaustive search.

To the northward, near Towong Gap, are various small lines of reef traversing a rather decomposed granite rock, in which are occasional embedded pieces of mica schist and sandstone. These reefs run in various directions, and have not been traced for any considerable distance in one line, but have in many cases, it is stated, yielded well for small crushings.

NOTES ON A RECENT CLASSIFICATION OF THE OLDER MARINE TERTIARY BEDS OF VICTORIA.*

By James Stirling, Assistant Geological Surveyor.

The Secretary for Mines.

I have the honour to submit some "Notes on a Recent Classification of the Older Tertiary Marine Beds of Victoria," together with a list of all the species known to occur in such beds now designated Eocene.

No similar list has so far as I am aware been presented to the Department for publication. The notes and accompanying list have at your request been referred to Sir F. McCoy, the Government Palæontologist, for perusal and comment, and the following communication has been received from Sir F. McCoy in regard to the matter.

"National Museum, Melbourne.

"Sir,—I have carefully examined the 'Notes on a Recent Classification of the Marine Tertiary Beds of Victoria,' together with a 'List of all the Species known to occur in such beds, now designated Eocene,' forwarded to me with a request that I would forward a report thereon.

"There is nothing in the notes or lists of fossils to alter my previous determination of the geological age of Muddy Creek, Schnapper Point, &c., amongst Victorian localities as Oligocene and not Eocene. I have not as yet seen any true Eocene strata in Victoria. The majority of the fossils had been many years ago described in my manuscripts, but the stoppage of the publication of the decades has enabled Professor

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* Remarks on the Tertiaries of Australia, with a catalogue of fossils, by G. B. Pritchard, South Australian School of Mines and Industries. Government Printer, Adelaide.

Tate and others to anticipate me in the priority of names. Many of those I will adopt, and some I disagree with, but this does not alter my opinion at all of these deposits which the Geological Survey of Victoria may safely accept on my authority as of newer date than any true Eocene Tertiary type, such as the London clay of the south-east of England, or the corresponding part of the Basin of Paris. The species of bivalves occurring in the greatest profusion of individuals are recent species, and not only do all the ordinary mollusca bear out my view of the more recent than Eocene date of the Victorian Tertiary beds known to me up to the present time, but the critical determination of the Polyzoa, which is now completed under the most favorable possible conditions, bears out this view even more strongly, inasmuch as about 12 per cent. of the species in Schnapper Point and Muddy Creek beds are recent species.

"In the long list of fossils sent to me there are no species characteristic of indisputable Eocene type sections. By far the greater number of the extinct species are peculiar to the Australian strata, and none of them are found in typical Eocene strata elsewhere.

"The whole seems an unfortunate case of arguing in a circle. Thus, if one should say Muddy Creek and Schnapper Point are Eocene; they contain some hundreds of species of fossils named, therefore these species are Eocene (1st fallacy). Then, these species being found in the strata of other localities prove by the rule that things which are equal to the same are equal to one another that these other localities are also Eocene (2nd fallacy).

"I have the honour to be, sir,
"Your most obedient servant,
"FREDERICK McCOY,
"Government Palæontologist.

"A. W. Howitt, Esq., F.G.S., Secretary for Mines,
"Department of Mines, Melbourne East."

The lowest members of the Marine Tertiary beds of Victoria have hitherto—upon certain palæontological evidence—been classed as Oligocene.[*] Upon such determinations, the Government Geologist has observed "that there appears to be no equivalents exposed in Victoria of the European or American Eocene beds,[†] and that the beds classed as Oligocene are the oldest members of the Tertiary series."

Recent researches at all the known localities both in eastern and western Victoria, by Professor Tate, of South Australia, and Messrs. Dennant, Pritchard, Hall, Sweet, and partly by the writer, has revealed a rich assemblage of fossils, which show a high percentage of forms said to be referable to an Eocene facies. A closer examination of the lithological character and stratigraphical sequence of the beds has disclosed an apparant break in the continuity of deposit between the beds which contain the alleged Eocene forms and those which are admittedly Miocene.[‡]

As the correct classification of the Marine Tertiaries of Victoria is of the highest importance in coordinating them with the terrestrial deposits, I deem it advisable to direct attention to the facts upon which the beds classed as Oligocene, and also at some localities classed as Miocene, have by the observers above named been referred to an Eocene age.

During the recent meeting of the Australasian Association for the advancement of science several papers which had a distinct bearing on this question were read.[§] From the discussion which followed it was evident that the time has now arrived when a better understanding among leading Australian palæontologists as to the precise nature of the data upon which the classification of the Tertiary beds is to be based should be arrived at.

It is now apparent that the Lower Marine Tertiaries of Victoria may be correlated with those of South Australia, and that the percentage of alleged Eocene forms in such lower beds is very great; and also it is shown that there is a stratigraphical break between the beds containing the larger percentage of the alleged Eocene forms and the overlying Miocene series.

Mr. Dennant, whose careful and persistent study of the tertiaries of Western Victoria,[‖] and Messrs. Hall and Pritchard on the Geelong and Portarlington beds,[¶] are in accord as to the chronological succession of the Lower Tertiary beds, which they have so critically examined with Professor Tate.

From a knowledge of the Snowy River and Bairnsdale beds, and a recent examination of the Murray Cliffs at Morgan, and on the coast at Aldinga, in company with Sir Jas. Hector, of New Zealand, Professor Tate, of South Australia, and Messrs. Dennant and Sweet, of Victoria, I am satisfied that the Victorian Marine Tertiaries may be correlated with those of South Australia, and that there is a distinct break in the deposition of the lowest series and certain oyster-beds with overlying Miocene fossils.

The determination of the Eocene age of such lower beds would involve a consideration of the age of the silicious conglomerates—which contain small beds of shale, with plant imprints—underlying the older basalts of Gippsland, as the latter underlie the alleged Eocene deposits of Flinders, and also at Eagle's Nest, near Airey's Inlet.

The localities where the Older Tertiary beds occur, and which are classed as Eocene by the beforementioned observers, are as follows :—

Snowy River.—Above Orbost are yellow clays, arenaceous and calcareous bands, containing such genera as pectunculus, lima, spondylus, limopsis, cucullea, turitella, solanella, and echinoderms. These, hitherto regarded as Miocene, are said to present an Eocene facies. The beds rest on Silurian and are overlaid by Pliocene gravels and bouldery beds, capped with Pleistocene sands.[**]

Mitchell River.—On the banks of the Mitchell River, near Bairnsdale, are calciferous and arenaceous beds which yield a number of fossils similar to those at Snowy River. To the south-east, on the margin of the Gippsland Lakes, the true Miocene beds are seen to rest against the basal part of the eroded escarpment of the forementioned alleged Eocene cliffs. A very concise description of the relation of these beds to the Upper Tertiaries of Gippsland is given by Mr. A. W. Howitt in Progress Report, Vol. II., p. 62.

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[*] "Progress Report of Geological Surveys," Vol. I., p. 35.

[†] "Physical Geography and Geology of Victoria," by R. A. F. Murray.

[‡] "Correlation of the Marine Tertiaries of Australia," Tate and Dennant. Transactions, Royal Society, South Australia.

[§] "On the Age of Certain Plant-bearing Beds," by G. B. Pritchard and T. S. Hall; "Census of the Fossil Foraminifera of Australia," by W. Howchin, F.G.S.; "The Physiography of South Gippsland," by J. Stirling, F.L.S.; The Igneous Rocks of South-west Victoria," by J. Dennant.

[‖] "Observations on the Tertiary and Post-Tertiary Geology of South-west Victoria," by J. Dennant, A.A.A.S., Vol. II., p. 441.

[¶] Hall and Pritchard on, Transactions Royal Society, Victoria, 1893.

[**] Notes on Prospecting Operations, Croajingolong, by J. Stirling, Quarterly Report, Mining Department, March, 1888, p. 87.

The lowest members of the Bairnsdale series hitherto regarded as Miocene are now by the observers before named regarded as Eocene. Mr. Howitt, in a footnote to his report, notices teeth of sharks, numerous gasteropods, including cypræa and dentalium ; also species of ostrea, pecten, and brachipods, echinoderms, and portions of the vertebræ of a toothed whale.

Geelong.—The Waurn Ponds rock, hitherto regarded as Miocene, is stated to underlie the deposits as at Orphanage Hill regarded as Oligocene or Upper Eocene.—Hall and Pritchard.*

Muddy Creek.—A very complete description of the character of these beds has been published by Mr. J. Dennant, who remarks that there are two well-marked zones. Out of 725 species collected at this locality, 511 have been traced to the lower beds. The percentage of recent to extinct forms is about 1½. The facies of the fauna being strikingly Eocene.—Dennant.†

Spring Creek.—Recent researches have shown that the former alleged distinction between the beds containing bivalves and others underlying them containing univalves does not exist, and that the greater number of species present analogies with the European Eocene Tertiaries. At Eagle's Nest, near Airey's Inlet, strata containing echinoderms and brachipods of same species as those at Spring Creek are underlain by basalt similar to that at Flinders.—Tate and Dennant.

Gellibrand.—The original remarks on the relation of the sections from certain observations of dip to determine the relation of the Miocene to the Oligocene blue clays, as at Curdie's, is stated to be erroneous. The echinoderms and polyzoa are referred to as characteristic Eocene forms. The rolls or undulations of the strata are sufficient to bring the same beds as at Camperdown and Muddy Creek into view.—Tate and Dennant.

Bullen Merri and Gnotuk Lakes.—Some 116 species of fossil shells have been collected on the banks of these lakes, all of which belong to the lower beds of the Muddy Creek and Gellibrand series.—Tate and Dennant.

Warrnambool.—Close to the mouth of the Hopkins River the rugged limestones contain such species as Chthalamus sp., Voluta sp., Pecten Foulcheri, P. gambieriensis, Waldhemia insolita, Magasella, Woodsiana, Lovenia Forbesi, spines of Cidaris and Bryozoa.—Tate and Dennant.

Mornington and Cheltenham.—Fully 400 species are now recorded from the Mornington beds, and 126 from Cheltenham. The former is stated to be certainly Eocene, and the latter to a higher level of the same group.—Tate and Dennant.

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* Transactions Royal Society, Victoria, 1891.

† "On the Tertiary and Post-Tertiary Geology of South-west Victoria," by J. Dennant, F.G.S., Proc. A.A.A.S., Vol. II., p. 441.

THE FOLLOWING SPECIES WHICH OCCUR IN THE LOWER TERTIARY BEDS OF VICTORIA HAVE BEEN REFERRED BY PROFESSOR TATE TO THE EOCENE* :—

This Tabulated List of Older Tertiary Fossils will prove useful for co-relation purposes.

—	Muddy Creek.	Gellibrand River.	Camperdown.	Spring Creek.	Geelong and Corio Bay.	Cape Otway.	Schnapper Point.	Mordialloc.	Cheltenham.	Flinders.	Bairnsdale.	E. Glenelg River.	Sherbrook River.	Port Phillip.	Moorabool Valley.	Shelford.	Waurn Ponds.	Portland.
CLASS.—ZOANTHRIA.																		
Microtrochus minutus (Woods)	+																	
Flabellum Candeanum (E. and H.)	+	+					+											
" distinctum (E. and H.)				+		+												
" pedicellare (Tate)	+	+	+		+	+	+											
" Victoriæ (Duncan)	+	+	+		+		+											
Placotrochus deltoideus (Duncan)	+	+		+	+				+									
" elongatus (Duncan)	+	+		+	+	+	+											
Notocyathus Australis (Duncan)	+	+		+			+											
" variolaris (Woods)	+		+															
" excisus (Duncan)	+	+		+					+									
" viola (Duncan)	+																	
Conocyathus cyclocostatus (Woods)	+																	
Trematrochus fenestratus (Woods)	+																	
Trochocyathus aff. Mantelli (Ed. and H.)				+														
" meridionalis (Duncan)		+																
Deltocyathus Italelus (Ed. and H.)	+	+	+	+		+												
Conotrochus McCoyi (Duncan)						+												
" typus (Sequenza)		+					+											
Smilotrochus vacuus (Woods)	+																	
Amphihelia incrustans (Duncan)						+												
Conismilia anomala (Duncan)	+	+			+													
" bicycla (Woods)	+																	
" elegans (Duncan)	+				+													
" lituola (Duncan)		+																
Antillia lens (Duncan)	+																	
Palæoseris Woodsi																		
Bathyactis discus																		
Cycleseris tenuis																		
Balanophyllia armata (Duncan)	+						+											
" Australiensis (Duncan)	+				+													
" campanulata						+												
" cylindrica (Micahelotti)						+												
" fragilis (Duncan)	+																	
" Selwyni (Duncan)				+		+												
" seminuda (Duncan)	+																	
" tubuliformis (Duncan)	+																	
" Ulrichi (Duncan)						+												
Graphularia senescens (Tate)				+														
CLASS.—ECHINODERMATA.																		
Cidaris Australiæ (Duncan)	+					+				+								
Ortholophus lineatus (Duncan)								+										
Scutellina patella (Tate)	+																	
Clypeaster Gippslandicus (McCoy)	+			+				+			+							
Monostychia Australis (Laube)								+										
Pygorhynchus vassali (Wright)												+						
Echinolampas Gambierensis (Woods)											+							
Echinobrissus Australiæ (Duncan)						+												
Holaster Australiæ (Duncan)						+												
Pericosmus compressus (McCoy)				+														
" " (McCoy)					+													
" Nelsoni (McCoy)					+													
Schizaster abductues (Tate)					+													
Maretia anomala (Duncan)													+					
Eupatagus Laubei (Duncan)													+					
CLASS.—PALLIOBRANCHIATA.																		
Terebratula vitreoides (T. Woods)	+			+						+				+				
Waldheimia Garibaldiana (Davidson)	+						+			+	+				+			
" furcata (Tate)															+			
" Tateana (T. Woods)	+										+							
" insolita (Tate)	+			+			+				+				+			
" grandis (T. Woods)					+						+						+	
" Vincentiana (Tate)					+													
" Corioensis (McCoy)	+			+	+										+		+	
Terebratulina Scoulari (Tate)	+	+	+	+	+		+			+					+			
" Davidsoni (Etheridge)	+			+											+			
" triangularis (Tate)					+													
Magasella compta (Sowerby)					+				+		+				+			
" Woodsiana (Tate)	+					+									+			
" Tenisoni (Woods)																		+
Thecidium Australe (Tate)	+																	
Rhynchonella squamosa (Hutton)	+									+							+	

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* Remarks on the Tertiaries of Australia, by G. B. Pritchard —Revised and extended by Prof. Tate.—(Government Printer, Adelaide.)

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued.*

—	**Muddy Creek.**	Gellibrand River.	Camperdown.	Spring Creek.	Geelong and Corio Bay.	Cape Otway.	Schnapper Point.	Mordialloc.	Cheltenham.	Flinders.	Bairnsdale.	E. Glenelg River.	Sherbrook River.	Port Phillip.	Moorabool Valley.	Shelford.	Waurn Ponds.	**Portland.**
CLASS.—LAMELLIBRANCHIATA.																		
Ostræa hyotis (Lim)	+														+			
Dimya dissimits (Hutton)	+			+		+	+				+				+			
Placunænomia Ione (Grey)	+											+						
″ sella (Tate)	+	+			+		+											
Pecten Murrayanus (Tate)	+						+								+			
″ dichotomalis (Tate)		+					+											
″ Antiaustralis (Tate)											+							
″ Sturtianus (Tate)	+																	
″ Yahlensis (Woods)	+	+			+		+				+						+	
″ Foulcherii (Woods)	+						+			+	+				+			
″ Gambierensis (Woods)											+				+			
″ polymorphoides (Zittel)	+										+				+			
″ Hochstetteri (Zittel)				+														
Amussium Zitteli (Hutton)	+	+		+			+				+				+			
Hinnites Corioensis (McCoy)	+				+						+				+			
Lima Bassii (T. Woods)	+						+				+				+			
″ linguliformis (Tate)	+						+								+			
″ Jeffreysiana (Tate)	+						+				+							
″ crebresquamata (Tate)				+														
Limea transenna (Tate)	+			+			+											
Spondylus pseudoradula (McCoy)	+	+					+		+		+							
Meleagrina crassicardia (Tate)	+																	
Penna sp.	+																	
Modiola sp.				+			+								+			
Septifer fenestratus (Tate)	+				+		+											
Modiolaria singularis (Tate)	+						+				+							
″ Corioensis (Tate)					+													
Crenella globularis (Tate)	+						+											
Nucula tumida (T. Woods)					+		+								+			
″ Atkinsoni (Johnston)	+				+		+								+			
″ Morundiana (Tate)	+														+			
Leda obolella (Tate)	+						+								+			
″ Huttoni (T. Woods)	+	+		+			+		+									
″ apiculata (Tate)	+	+		+			+								+			
″ vagans (Tate)	+	+		+	+		+		+		+				+			
″ prælonga (Tate)	+																	
″ Woodsii (Tate)	+																	
Limopsis insolita (Sowerby)				+														
″ aurita (Brocchi)	+			+			+				+				+			
″ Belcheri (Adams and Rewe)	+	+		+	+		+		+						+			
Pectunculus Cainozoicus (T. Woods)	+			+					+						+			
″ laticostatus (Quoy and Gaimard) ...				+														
″ McCoyii (Johnston)	+	+					+		+		+				+			
″ subtrigonalis (Tate)	+																	
Barbatia crustata (Tate)	+						+											
″ celleporacea (Tate)	+	+					+				+				+			
″ consutilis (Tate)	+																	
″ simulans (Tate)	+						+				+							
″ pumila (Tate)	+																	
Macrodon Cainozoicus (Tate)	+	+			+		+				+				+			
Cucullæa Corioensis (McCoy)	+	+		+	+		+		+		+							
Trigonia semiundulata (McCoy)	+			+														
″ tubulifera (Tate)	+	+		+			+								+			
″ acuticostata (McCoy)									+									
Crassatella Dennanti (Tate)	+	+					+								+			
″ Halli (Tate)				+														
″ astartiformis (Tate)	+	+		+			+								+			
Carditella polita (Tate)	+																	
″ inornata (Tate)				+														
″ multilamella (Tate)	+																	
Cardita compacta (Tate)	+								+						+			
″ scabrosa (Tate)	+	+			+		+								+			
″ gracilicostata (T. Woods)	+														+			
″ polynema (Tate)		+		+			+								+			
″ delicatula (Tate)	+	+					+		+						+			
″ calica (Tate)	+								+									
Mytilicardia alata (Tate)				+														
″ sp.				+														
Lucina leucomomorpha (Tate)	+																	
″ projecta (Tate)	+																	
″ araneosa (Tate)	+																	
″ despectans (Tate)	+																	
Cryptodon mactræformis (Tate)	+																	
Diplodonta subquadrata (Tate)				+														
″ suborbicularis (Tate)	+																	
″ crepidulæformis (Tate)	+																	
Montacuta sericea (Tate)	+																	
Chama lamellifera (T. Woods)	+	+		+			+				+				+			
Verticordia pectinata (Tate)	+																	

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued.*

—	Muddy Creek.	Gellibrand River.	Camperdown.	Spring Creek.	Geelong and Corio Bay.	Cape Otway.	Schnapper Point.	Mordialloc.	Cheltenham.	Flinders.	Bairnsdale.	E. Glenelg River.	Sherbrook River.	Port Phillip.	Moorabool Valley.	Shelford.	Waurn Ponds.	Portland.
Cardium pseudomagnum (McCoy)				+														
〃 Victoriæ (Tate)	+																	
〃 cuculloides (Tate)	+														+			
〃 antisemigranulatum (McCoy)	+			+											+			
〃 hemimeris (Tate)	+			+			+											
Chione Allporti (T. Woods)								+										
〃 multilamella (Tate)				+														
〃 Pritchardi (Tate)				+														
〃 dimorphophylla (Tate)	+																	
〃 Cainozoica (T. Woods)	+			+			+											
〃 propinqua (T. Woods)	+			+	+													
〃 Corioensis (Tate)					+													
Cytherea eburnea (Tate)	+	+		+	+		+				+				+			
Tellina Masoni (Tate)	+																	
〃 Stirlingi (Tate)	+																	
Strigilla Australis (Tate)	+																	
Donax Dixoni (Tate)	+																	
Semele vesiculosa (Tate)	+														+			
〃 Krauseana (Tate)	+						+											
Mactra Hawchiniana (Tate)	+						+											
Thracia perscabroca (Tate)	+																	
Myodora tenuilirata (Tate)	+	+		+	+		+		+						+			
〃 Australis (Johnston)	+																	
〃 æquilateralis (Johnston)							+											
Corbula ephamilla (Tate)	+	+		+	+		+		+						+			
〃 pixidata (Tate)		+		+			+				+				+			
Neaera subrostrata (Tate)	+						+											
Panopæa Agnewi (T. Woods)				+														
〃 orbita (Hutton)	+																	
Capistrocardia fragilis (Tate)							+											
Solecurtis Dennanti (Tate)	+			+														
Teredo sp.	+			+														
Aspergillum sp.				+					+									
〃 liratum (Tate)	+																	
CLASS.—GASTROPODA.																		
Murex velificus (Tate)	+	+					+								+			
〃 rhysus (Tate)	+						+											
〃 didymus (Tate)							+											
〃 lophoessus (Tate)	+	+					+								+			
〃 Dennanti (Tate)	+																	
〃 amblyceras (Tate)	+	+					+								+			
〃 Hamiltonensis (Tate)	+																	
〃 irregularis (Tate)	+																	
〃 asteriscus (Tate)	+																	
〃 pachystirus (Tate	+																	
〃 Eyrei (T. Woods)	+	+		+			+								+			
〃 camplytropis (Tate)	+	+					+								+			
〃 asperulus (Tate)	+	+		+			+								+			
〃 trochispira (Tate)	+														+			
〃 alveolatus (Tate)	+																	
Typhis McCoyii (T. Woods)	+			+											+			
〃 acanthopteris (Tate)							+											
〃 disjunctus (Tate)	+						+											
〃 laciniatus (Tate)	+														+			
〃 evaricosus (Tate)	+														+			
〃 sp.															+			
Trophon polypyllus (T. Woods)	+	+		+			+								+			
〃 brevicaudatus (Tate)	+																	
〃 sp.		+																
Rapana aculeata (Tate)	+						+								+			
Vitularia curtansata (Tate)	+																	
Ranella Prattii (T. Woods)	+	+					+								+			
Triton gibbus (Tate)	+	+					+								+			
〃 cyphus (Tate)	+						+								+			
〃 Woodsii (Tate)	+	+					+								+			
〃 textilis (Tate)	+	+					+								+			
〃 intercostalis (Tate)	+																	
〃 annectans (Tate)	+	+																
〃 tumidosus (Tate)	+	+					+								+			
〃 tortirostris (Tate)	+	+		+			+								+			
〃 protensus (Tate)							+											
〃 gemmulatus (Tate)	+	+		+			+								+			
Distorsio n. sp.				+														
Epidromus tenuicostatus (T. Woods)	+						+											
〃 citharellus (Tate)	+																	
〃 leptoskeles (Tate)	+																	
〃 texturatus (Tate)	+						+											
〃 turritus	+						+											

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued.*

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Fusus foliaceus (Tate)	+	+					+								+			
〃 acanthostephes (Tate)	+	+					+								+	+		
〃 craspedotus (Tate)	+	+					+								+			
〃 senticosus (Tate)	+						+								+			
〃 dictyotis (Tate)	+						+								+			
〃 simulans (Tate)	+																	
〃 hexagonalis (Tate)	+														+			
〃 bulbodes (Tate)	+						+											
〃 henicus (Tate)	+																	
Latirofusus aciformis (Tate)	+						+								+			
Siphonalia subreflexa (G. B. Sow.)	+																	
〃 longirostris (Tate)	+	+					+											
〃 sp.															+			
〃 Tatei (Cossman)	+	+					+								+			
Sipho labrosus (Tate)	+														+			
〃 crebrigranosus (Tate)	+																	
〃 styliformis (T. Woods)	+						+								+			
Pseudovaricia mirabilis (Tate)	+																	
Fasciolaria Tenisoni (T. Woods)	+						+								+			
〃 exilis (Tate)	+			+			+											
〃 concinna (Tate)							+											
〃 decipiens (Tate)	+														+			
〃 fusilla (Tate)	+																	
〃 cristata (Tate)	+	+					+								+			
〃 cryptoploca (Tate)	+						+								+			
〃 rugata (Tate)	+	+					+								+			
〃 lamellifera (Tate)							+											
Peristernia lintea (Tate)	+	+													+			
〃 succincta (T. Woods)	+	+																
〃 interlineata (Tate)	+																	
〃 subundulosa (Tate)	+														+			
〃 crassilabrum (Tate)				+														
〃 n. sp.							+											
Tudicula turbinata (Tate)	+																	
〃 angulata (Tate)	+																	
Dennantia Ino (T. Woods)	+	+					+								+			
〃 cingulata (Tate)	+						+											
〃 n. sp.		+													+			
Leucozonia micronema (Tate)							+											
〃 staminea (Tate)		+					+								+			
〃 tumida (Tate)	+																	
Zemira præcursoria (Tate)	+																	
Eburnopsis n. sp.				+														
〃 aulacœssa (Tate)	+																	
Pisania purpuroides (Johnston)	+																	
〃 brevis (Tate)	+																	
〃 sp.		+																
Phos tardicrescens (Tate)	+														+			
〃 cominelloides (Tate)	+																	
〃 variceferus (Tate)	+	+					+											
Nassa Tatei (T. Woods)	+	+					+								+			
Voluta Hannifordi (McCoy)	+	+					+								+			
〃 alticostata (Tate)	+																	
〃 MacDonaldi (Tate)	+	+					+								+			
〃 macroptera (McCoy)				+														
〃 Mortoni (Tate)	+																	
〃 limbata (Tate)		+					+											
〃 conoidea (Tate)	+														+			
〃 ancilloides (Tate)	+	+					+								+			
〃 McCoyii (T. Woods)	+	+					+				+				+			
〃 polita (Tate)	+						+								+			
〃 ellipsoidea (Tate)	+																	
〃 crassilabrum (Tate)	+																	
〃 sarissa (Tate)	+																	
〃 costellifera (Tate)	+														+			
〃 lirata (Johnston)	+																	
〃 pseudolirata (Tate)	+						+								+			
〃 cathedralis (Tate)	+														+			
〃 pagodoides (Tate)				+														
〃 antiscalaris (McCoy)	+	+					+		+						+			
〃 anticingulata (McCoy)				+														
〃 strophoden (McCoy)	+	+					+								+			
〃 Weldii (T. Woods)	+																	
〃 n. sp.				+														
〃 n. sp.															+			
Lyria harpularia (Tate)	+						+								+			
Mitra alokiza (T. Woods)	+	+					+								+			
〃 Dennanti (Tate)	+																	
〃 dictua (T. Woods)	+						+											
〃 uniplica (Tate)							+											
〃 ligata (Tate)	+			+			+								+			
〃 othone (T. Woods)	+																	

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued.*

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Mitra atractoides (Tate)	+														+			
„ escharoides (Tate)	+																	
„ leptalea (Tate)	+						+											
„ exilis (Tate)	+																	
„ paucicostata (Tate)	+						+											
„ clathurella (Tate)	+																	
„ biornata (Tate)	+														+			
„ semilævis (Tate)	+						+											
„ conoidalis (Tate)	+						+											
Marginella Woodsii (Tate)	+									+					+			
„ propinqua (Tate)	+	+		+			+								+			
„ Winteri (Tate)	+			+														
„ micula (Tate)	+			+			+								+			
„ inermis (Tate)	+						+								+			
„ Wentworthi (T. Woods)	+	+		+			+								+			
„ cassidiformis (Tate)	+																	
„ septemplicata (Tate)	+																	
„ sub-Wentworthi (Tate)							+											
Oliva augustata (Tate)	+				+													
„ n. sp.						+												
Ancillaria hebera (Hutton)	+																	
„ subampliata (Tate)	+																	
„ lanceolata (Tate)	+																	
„ semilævis (Tate)	+			+			+								+			
„ pseudaustralis (Tate)...	+						+				+				+			
„ n. sp.				+														
„ (?) n. sp.									+									
Harpa lamellifera (Tate)	+						+											
„ sulcosa (Tate)	+																	
„ spirata (Tate)							+											
„ abbreviata (Tate)	+														+			
„ tenuis (Tate)	+						+											
„ pulligera (Tate)...							+											
„ pachycheila (Tate)				+														
Columbella infans (Tate)	+																	
„ cochleata (Tate)	+																	
„ cingulata (Tate)	+																	
„ nodulosa (Tate)	+																	
„ atratæformis (Tate)	+																	
„ subspeciosa (Tate)	+																	
„ semicostata (T. Woods)	+																	
„ funiculata (T. Woods)	+						+											
„ clathrata (Tate)	+						+											
„ oryza (Tate)	+																	
„ Oxleyi (T. Woods)							+											
„ aciculata (Tate)	+																	
„ oligostira (Tate)	+																	
„ crebricostata (T. Woods)	+						+											
„ cominelloides (Tate)	+																	
„ septemcostata (Tate)	+																	
„ Cainozoica (T. Woods)				+			+								+			
Cancellaria calvulata (Tate)							+											
„ laticostata (T. Woods)	+	+		+			+								+			
„ alveolata (Tate)	+																	
„ epidromiformis (Tate)	+	+		+			+								+			
„ gradata (Tate)	+						+											
„ semicostata (Tate)	+																	
„ Etheridgei (Johnston)				+														
„ caperata (Tate)							+											
„ capillata (Tate)	+																	
„ n. sp.							+											
Terebra platyspira (Tate)	+			+			+								+			
„ mutica (Tate)	+																	
„ simplex (T. Woods)	+			+														
„ additoides (T. Woods)									+									
„ leptospira (Tate)	+																	
„ n. sp.							+											
Pleurotoma perarata (Tate)	+																	
„ Murndaliana (T. Woods)	+						+								+			
„ Claræ (T. Woods)	+	+													+			
„ consutilis (T. Woods)	+																	
„ Samueli (T. Woods)	+																	
„ rhomboidalis (T. Woods)	+																	
„ paracantha (T. Woods)	+						+											
„ Johnstoni (T. Woods)	+																	
„ sp.	+																	
„ n. sp.							+											
Dolichotoma atractoides (Tate)	+	+					+				+				+			
„ cataphractoides (Tate)	+	+					+								+			
Drillia Trevori (T. Woods)	+														+			
„ integra (T. Woods)	+						+								+			
„ sp.	+	+		+			+								+			

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued*.

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Mangilia bidens (T. Woods)	+	+					+								+			
〃 sp.	+	+		+			+								+			
Bela sculptilis (Tate)	+			+														
〃 pulchra (Tate)	+																	
〃 crassilirata (Tate)	+																	
〃 cancellata (T. Woods)	+																	
〃 Woodsii (Tate)				+														
〃 sp.							+								+			
Clathurella sp.	+																	
Borsonia sp.					+													
Pusionella hemiothone (T. Woods)	+	+		+			+								+			
〃 sp.	+	+		+											+			
Daphnella tenuisculpta (T. Woods)	+						+											
〃 gracillima (T. Woods)	+			+			+								+			
〃 fragilis (Tate)	+																	
〃 inornata (Tate)	+																	
〃 sp.	+			+			+											
Raphistoma daphnelloides (T. Woods)	+						+											
〃 sp.							+											
Clavatula fusilla (Tate)	+																	
〃 texturata (Tate)	+						+											
Conus cuspidatus (Tate)	+						+								+			
〃 ptychodermis (Tate)	+																	
〃 complicatus (Tate)	+						+											
〃 pullulescens (T. Woods)	+						+											
〃 ligatus (Tate)	+	+					+								+			
〃 heterospira (Tate)				+			+											
〃 Ralphii (T. Woods)	+																	
〃 acrotholoides (Tate)							+											
〃 extenuatus (Tate)	+			+					+									
〃 Hamiltonensis (Tate)	+						+								+			
〃 sp.	+			+			+								+			
Cypræa parallela (Tate)	+						+											
〃 scalena (Tate)	+						+											
〃 subsidua (Tate)	+														+			
〃 ampullaceæ (Tate)							+											
〃 contusa (McCoy)	+	+					+								+			
〃 subpyrulata (Tate)	+														+			
〃 brachypyga (Tate)	+						+								+			
〃 pyrulata (Tate)	+						+								+			
〃 *Murraviana (Tate)											+							
〃 leptorhyncha (McCoy)	+			+			+		+						+			
〃 eximia (G. B. Sowerby)	+	+					+								+			
〃 Mulderi (Tate)					+													
〃 sphærodoma (Tate)	+																	
〃 toxorhyncha (Tate)	+																	
〃 platypyga (McCoy)	+	+					+											
〃 consobrina (McCoy)															+			
〃 platyrhyncha (McCoy)				+														
〃 gigas (McCoy)	+	+					+								+			
〃 dorsata (Tate)	+						+											
〃 gastroplax (McCoy)							+											
Trivia avellanoides (McCoy)	+	+		+	+		+				+				+			
〃 erugata (Tate)	+																	
Erato minor (Tate)	+						+											
〃 Australis (Tate)				+														
〃 Morningtonensis (Tate)							+											
Simnia exigua (Tate)	+																	
Cassis exigua (T. Woods)	+														+			
〃 textilis (Tate)									+									
Semicassis transenna (Tate)	+	+					+								+			
Cassidaria gradata (Tate)	+	+					+								+			
〃 Wilsoni (Tate)				+														
Natica auriculata (Tate)	+						+								+			
〃 Wintlei (T. Woods)	+																	
〃 perspectiva (Tate)	+																	
〃 gibbosa (Hutton)	+										+				+			
〃 limata (Tate)	+						+											
〃 Hamiltonensis (T. Woods)	+	+		+			+		+						+			
〃 polita (T. Woods)	+	+		+			+				+				+			
〃 paludinæformis (Tate)	+																	
〃 n. sp.															+			
Trochita rhysa (Tate)	+						+											
Calyptræa undulata (Tate)				+														
Crepidula sp.							+								+			
Capuliss turbinata (T. Woods)	+																	
Hipponyx foliaceus (Quoy and Gaimard) ...	+																	
Xenophora Tatei (Cossman)	+						+								+			
Solarium acutum (T. Woods)	+	+													+			
〃 ephamilla (Tate)	+																	
〃 Wannonensis (T. Woods)	+																	
Crossea princeps (Tate)	+																	

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* Near Mount Arapiles.

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued.*

—	Muddy Creek.	Gellibrand River.	Camperdown.	Spring Creek.	Geelong and Corio Bay.	Cape Otway.	Schnapper Point.	Mordialloc.	Cheltenham.	Flinders.	Bairnsdale.	E. Glenelg River.	Sherbrook River.	Port Phillip.	Moorabool Valley.	Shelford.	Waurn Ponds.	Portland.
Crossea sublabiata (Tate)	+																	
Scalaria interstriata (Tate)	+																	
〃 basinodosa (Tate)	+																	
〃 prionata (Tate)	+																	
〃 Hamiltonensis (Tate)	+																	
〃 echinophora (Tate)					+													
〃 foliosa (Tate)							+											
〃 orycta (Tate)	+																	
〃 bulbulifera (Tate)	+																	
〃 eritima (Tate)	+																	
〃 microrhysa (Tate)				+														
〃 transenna (Tate)							+											
〃 pleiophylla (Tate)				+	+													
〃 pachypleura (Tate)	+																	
〃 escharoides (Tate)	+																	
CLASS.—GASTEROPODA.																		
Scalaria (acrilla) glyphospira (Tate)	+																	
〃 〃 mutica (Tate)	+																	
〃 cylindracea (Tate)	+																	
〃 goniodes (Tate)	+																	
〃 crebrilamellata (Tate)	+																	
〃 polynema (Tate)				+														
Trichotropis subquadrata (Tate)	+																	
〃 accrescens (Tate)	+																	
〃 quinquelirata (Tate)				+														
〃 apicilirata (Tate)				+														
Turitella platyspira (Woods)	+						+											
〃 Murrayana (Tate)	+														+			
〃 acricula (Tate)											+							
〃 septifraga (Tate)				+														
〃 several sp.	+	+		+			+		+	+	+				+			
Siliquaria squamulifera (Tate)	+	+		+			+				+				+			
〃 unguiculifera (Tate)															+			
Vermetus conohelix (Woods)	+	+		+			+								+			
Eulima Danae (Woods)	+	+		+			+				+				+			
Leiostraca Johnstoniana (Tate)	+																	
Niso psila (Woods)	+	+					+								+			
Turbonilla sp.	+						+											
Mathilda transenna sp.	+																	
Odostomia sp.	+						+								+			
Syrnola sp.	+																	
Pyramidella sp.	+																	
Cerethium apheles (T. Woods)	+	+					+								+			
〃 eusmilia (T. Woods)	+																	
〃 crebarioides (T. Woods)	+	+					+								+			
〃 salteriana (T. Woods)																		
Cerithiopsis sp.	+	+		+			+								+			
Triforis Wilkinsoni (T. Woods)	+						+								+			
〃 sulcata (T. Woods)	+																	
〃 planata (T. Woods)	+																	
〃 sp. sp.		+		+			+											
Rissoa chrysalida (Tate)															+			
〃 sp. sp.	+						+								+			
Rissoina punctifera (Tate)							+											
Liotia Roblini (T. Woods)	+						+			+								
〃 sp. sp.	+						+								+			
Cyclostrema carinata (T. Woods)	+																	
〃 sp.	+														+			
Collonia infralineata (Tate)	+																	
〃 parvula (T. Woods)	+																	
Australium Flindersi (T. Woods)	+																	
Turbo sp.							+											
Trochus sp.	+						+				+				+			
Minolia strigata (T. Woods)	+																	
〃 sp.	+										+							
Gibbula acquisulcata (T. Woods)	+																	
Elenchus sp.	+																	
Diloma sp.	+																	
Euchelus sp.	+																	
Leiopyrga Sayceana (Tate)									+									
Calliostoma sp.	+			+			+		+									
Cantharidus sp.	+	+		+			+											
Delphinula aster (Woods)	+						+											
Sequenzia radialis (Tate)	+																	
Fissurellidæa Malleata (Tate)	+	+					+				+				+			
Hemitoma occlusa (Tate)	+	+					+								+			
Emarginula candida (Tate)	+						+								+			
〃 transenna (Tate)	+						+											
〃 cymbium (Tate)	+					+									+			

SPECIES IN LOWER TERTIARY BEDS, ETC.—*continued.*

—	Muddy Creek.	Gellibrand River.	Camperdown.	Spring Creek.	Geelong and Corio Bay.	Cape Otway.	Schnapper Point.	Mordialloc.	Cheltenham.	Flinders.	Bairnsdale.	E. Glenelg River.	Sherbrook River.	Port Phillip.	Moorabool Valley.	Shelford.	Waurn Ponds.	Portland.
Emarginula sp. sp.	+	+					+								+			
Acmæa sp. sp.	+																	
Chiton sp. sp.	+	+					+											
Scaphander fragilis (Tate)	+						+								+			
Tornatina sp.	+																	
Ringicula lactea (Johnston)	+																	
〃 sp.							+								+			
〃 S. Australis															+			
Tornatella scorbiculata (Woods)	+																	
〃 biomata (Tate)	+																	
〃 sp.				+														
Cylichna exigua (Woods)	+	+		+											+			
〃 sp. sp.	+	+		+	+		+		+		+				+			
Bulla scrobiculata (Woods)	+				+										+			
Umbrella austrina (Tate)	+						+				+				+			
CLASS.—SCAPHOPODA.																		
Entalis Mantelli (Zittel)	+	+		+	+		+		+		+				+			
〃 subfissura (Tate)	+	+		+					+		+				+			
〃 annulatum (Tate)	+			+														
〃 acriculatum (Tate)	+																	
Dentalium aratum (Tate)	+	+					+								+			
〃 bifrons (Tate)																		
〃 lacteum (Tate)	+																	
Cadulus mucronatus	+																	
CLASS.—PTEROPODA.																		
Styliola Rangiana (Tate)	+						+											
〃 bicarinata (Tate)	+																	
Vaginella eligmostoma (Tate)	+						+											
Spiralis tertiaria (Tate)	+						+											
CLASS.—CEPHALOPODA.																		
Nautilus sp.	+	+					+									+		
Aturia Australis (McCoy)	+	+					+		+							+		
Sepia 〃	+																	
Spirulirostra curta (Tate)				+														

NOTES ON CERTAIN GEOLOGICAL FEATURES OF THE PARISHES OF GEMBROOK NORTH AND NANGANA.

(*By W. H. Ferguson.*)

Having been engaged in geologically colouring the parishes of Gembrook North and Nangana, I have the honour to submit a few notes to accompany plans. The south-east portion of the country traversed is mainly occupied by granite. This granite differs in some respects from the typical granite of the colony; at times it is a coarse-grained variety, with large crystals of quartz and felspar and the normal quantity of mica, this rock yields a poor gritty soil. At others it contains hardly any crystalized quartz, but abundance of mica, the decomposition of this rock produces a fine chocolate soil. In the bed of Tomahawk Creek, near its junction with Shepherd's Creek, Nangana East, the actual junction of the granite with the Silurian rocks may be seen in ground plan. The granite invades, indurates, and absorbs the Upper Silurian rocks, and traverses them with dykes and veins. The mixture of the two rocks produces numerous varieties of granitic rocks, some are coarsely porphyritic, others fine-grained and felspathic, and all varieties of rocks are visible, from ordinary granite to indurated Silurian rocks. After the main mass of granite had cooled, veins and dykes of fine-grained granite were forced up through shrinkage cracks, and now traverse both granite and Silurian alike; some of the veins contain small garnets. One small isolated piece of Silurian rock shows threads of granite through it, and an inspection of the site indicates clearly that the granite is the younger and invading rock. At the Earl of Hopetoun claim, near Warburton, an auriferous dyke is being worked in the granite—this is the same belt of granite that runs south-east to Shepherd's Creek without a break—and it there indurates the Upper Silurian rocks after they have been compressed, uptilted, and denuded. From this fact it is probable that the gold was deposited in the dyke during the Devonian or some later period, as the dyke is of younger age than the main mass of granite. At Shepherd's Creek alluvial gold is stated to have been obtained from granite country; this gold may have originally been included in the Silurian rocks, as the granite has absorbed a quantity of Silurian rock; and, if that rock were auriferous, the gold would probably now exist in the granite, or, where the granite has undergone denudation, the gold would be found in creek beds and washes. The trap of the district is connected with the large trappean occurrence at Fern Tree Gully and the Dandenong State Forest, and numerous trappean dykes occur throughout the district. The trap is intimately connected with the granite, and wherever the two formations join, the one rock merges into the other without a break, the granite gradually gets more and more trappean in character, till the one rock gives place to the other. The Silurian rocks occur as surface rock over a large part of Gembrook and most of Nangana, the formation consists of sandstones and mudstones numerous reefs occur in the sandstone rocks, but in the majority of instances contain very little gold. In the early mining days a considerable quantity of gold was obtained at the Emerald Diggings; the formation is Silurian mudstones. The mining was done mostly near the junction of the trap rocks. The mudstones are soft and earthy, variously coloured white, grey, yellow, pink, or black, some varieties much resemble a decomposed igneous rock; the black-coloured stone has yielded a graptolite resembling the Upper Silurian variety graptolithus priodon. It seems strange that the source of the alluvial gold obtained at these diggings has not been discovered. The great amount of surface soil covering the rock is against successful prospecting, but by systematic loaming it is probable that auriferous reefs or dykes would be found. During the Miocene period a system of rivers flowed over the district from the south towards the north; the surface drainage was then different to what it is now, as a flow of older basalt, covering a deep lead, indicates that a river crossed the present divide between Gippsland and the Yarra. The boulder-wash found in the lead under the basalt at Crighton's Freehold would suggest that a large swiftly-flowing river originally flowed down the valley in the Silurian rocks, which is now filled in by basalt. Disconnected patches of basalt indicate that rivers flowed down north towards the site of the present Yarra. Around these basaltic outliers gold has been obtained, but, except at Crighton's Freehold, never under the basalt. An attempt was made to tunnel under the lava at block D, Macclesfield, Nangana, but for want of funds the project was abandoned, though the chances of striking payable wash appear to be good. At Crighton's Freehold fossil leaves and limestone pebbles have been obtained under basalt; the leaves have a Miocene aspect; the limestone is curious, it contains Upper Silurian fossils, and resembles the Lilydale stone, and points to the existence of limestone to the south of the working. In this district may be seen, in a most striking manner, the effect of the rock formations on vegetation, over the basaltic, trappean, the Silurian mudstones, and occasionally the granite areas, which all yield a deep rich soil; the vegetation is most luxuriant, dense, almost impenetrable scrubs and giant timber flourish, while the Silurian sandstones and the poorer granite country only support bayonet grass and stunted timber. There is a very heavy rainfall over this part of the colony; the rocks decompose freely and yield a great depth of soil. There are no road or railway cuttings where the rocks may be seen in section, and it is difficult to obtain information as to the relations of the formations to each other.

GEOLOGICAL NOTES ON THE COUNTY OF DUNDAS.

(*By W. H. Ferguson.*)

I have the honour to forward a few notes on the general geology of the county of Dundas. The most of the county, with the exception of the Dundas, Grampian, and Victoria Ranges, has at one time been a level tract of country, but since Pliocene times denudation has eroded creeks and rivers through the general level down to Miocene limestone, Mesozoic and Palæozoic rocks, and to granite. The whole district is still greatly covered over by Tertiary formations, and with the exception of the ranges mentioned it is only where aerial denudation has worn hollows that the older rocks may be seen. The Tertiary rocks consist of sands, sandstones, and ferruginous sandstones, pebbly conglomerates, and coralline limestone. The limestone was noted at Roseneath and Woodburn, and the fossils, which include a trigonia semiundulata, have a Miocene aspect. The ferruginous sandstones are fossiliferous at Nolan's Creek, Harrow, Chetwynd, and at Koolomert, and probably belong to the Lower Pliocene formation. At Balmoral these ferruginous sandstones and fine pebbly conglomerates yield a dark-coloured but useful building stone. The Mesozoic rocks may be seen at the surface at Casterton; from there they extend up the Glenelg as far as Roseneath, where they may be seen passing under the Tertiary rocks. From the junction of the Glenelg with the Wannon the Mesozoic rocks occur along the latter river to within 4 or 5 miles of Redruth. Clays, ironstones, and sandy limestones are the principal rocks of the formation. In a railway cutting 2 miles from Coleraine two small seams of lignite were noted in these rocks. From the ironstones some fine fossils were obtained. They were specimens of tæniopteris, sphenopteris, and a unio. A splendid soil results from the decomposition of the Mesozoic rocks. About Coleraine there is a deposit of glacial conglomerate which closely resembles the formation at Heathcote as described by Mr. E. J. Dunn. The matrix is a stiff shaly clay, studded with a great variety of pebbles and boulders, which are often polished and striated; stones from the deposit would range from the size of peas up to blocks weighing a ton. No clear section could be seen showing the relation of the glacial conglomerate to the Mesozoic rocks, but from the configuration of the hills the glacial deposit appears to underlie the Mesozoic formation.

In Keonong Wootong Creek, near two small hills called Adam and Eve, building stone has been quarried from a dyke or porphyry. This dyke in one excavation may be seen cutting through the glacial conglomerate; in another opening higher up the hill it intersects a blue igneous rock, probably of Trappean age. The trap rock resembles a flow, and the two small hills were probably once connected with each other, and with various other isolated portions of similar rock which occur throughout the district. Similar rock may be seen at Carrapook resting on the metamorphic schists.

At the Dundas, Victoria, and Grampian Ranges, and at Mount Bepcha, the formation called Grampian sandstone is met with. Fine and coarse grained sandstone, with occasionally a few water-worn quartz pebbles, and a layer of red shale at Brim Springs, were the rocks noticed. From the rock from this formation two fine houses have been built, one at Glenisla, built of stone from the Victoria Range and Mount Bepcha; and for the other, at Gringegalgona, which has been built for over twenty years, the stone was quarried at the Dundas Range, and it has kept the colour well. A close examination of these rocks for fossils was not rewarded by any specimens. Trap rocks occur in connexion with the sandstones. At Wartook Falls it is clearly intrusive, and at its junction with the sandstones indurates those rocks considerably. The strike of the Victoria Range is peculiar; it is N.E. north of Chimney-pot Gap, and south of the Gap it is north-west. Just east from the Gap there is a large extent of Trappean rock. The rock appears to be intruded between the layers of sandstone, and has probably bulged the sandstone out westward. The rock at the Gap dips in all directions, and shows the effect of great strain and pressure. Denudation would act more rapidly on rocks that had been fractured and broken than on those that were in the ordinary condition of the range, and thus the Gap has been worn through the range at this particular spot.

In a number of the deeper creeks metamorphic rocks may be seen, they are varieties of gniess, gniessoze schists, and mica schist. At Nolan's Creek the rock-bands are Silurian, presumably Lower Silurian, some rocks are ordinary quartzites and indurated sandstones, other layers have been metamorphosed, the slates to schists, and the two bands of limestone to shaly marble; other beds appear to be tuffs; certain beds of sandstone enclose water-worn pebbles of quartz and other rocks. These rocks of Nolan's Creek are evidentally younger than, and unconformable to, the granitic metamorphic rocks of the Upper Steepbank Creek, some 5 or 6 miles away. The tuffs and water-worn pebbles would indicate that land or at least shallow water existed when these rocks were being laid down. The limestone also points to a moderate depth of water at the time it was accumulated. Typical granite is met with only in two or three localities in the district, at Spring Vale the best sample was noticed. Much of the rock coloured as granite near Harrow is evidently the extreme result of metamorphic action on sedimentary strata. In a cutting 1 mile from Harrow on the Balmoral-road small patches of mica schist may be seen in the midst of the granite which have escaped absorption by the granitizing influences which have altered the surrounding strata into granite. Large dykes of pegmatite, and graphic granite which intersect the granite and metamorphic rocks are frequently met with throughout the district wherever the latter rocks occur. Trappean rocks, porphyry, and greenstone outcrop at the surface near Balmoral, Glendinning, Cavendish, and on the Wannon at the Nigretta Falls. A patch of rock resembling older basalt occurs at Chetwynd, and yields the usual rich soil by decomposition. At the Wannon Falls, newer basalt overlies ironstones, which are fossiliferous, very distinct impressions of leaves and feathers have been submitted to Professor McCoy for identification. The basalt covers an old land surface, and quite envelops the stump of a tree, the wood of which is fairly well preserved. It appears that the lava has actually surrounded the tree stump without burning the wood. Vivianite crystals were obtained in the wood, and in the decomposed basalt near the stump. Numerous quartz reefs were noticed in various parts of the county, but for the most part did not appear to be associated with any precious metal. In the Major's Creek there is a large quartz reef, which judging from the small portion exposed is a true anticlinal reef. Traces of gold may be obtained in several creeks that flow through metamorphic rocks, but in very small quantities. Gold, silver, lead, and copper have been obtained from the lodes in the schists of Nolan's Creek. Similar schists are to be seen on the Glenelg River, near the boundary of the parishes of Ganoo Ganoo and Youpayang.

NOTES ON THE ROCKS AT DOOKIE.

(*By W. H. Ferguson.*)

The rocks which outcrop at Dookie township appear to belong to the same formation as a series of very ancient rocks which occur in the Heathcote district. They are quite distinct from the Silurian formation of the gold-fields, or from the granitic and metamorphic rocks of the north-eastern district, or those of the county of Dundas. There is a series of dolerites and diorites, dense hard blue rocks, which often contain pyrites and weather-brown, with an outer shell resembling basalt. These rocks pass from very fine grained to coarser crystalline rocks, which contain hornblende, and sometimes appear to be mainly composed of hornblende. Bands of ironstone belong to the formation, the rocks pass from ferruginous schist to stone containing a high percentage of iron. A small quarry for road metal has been opened in a bed of chert; this rock resembles the chert beds of the "Ladies' Pass" at Knowsley East; it weathers into minute angular fragments, and if these fragments were enveloped in silica, a rock would probably be produced resembling the upper silurian breccia of Heathcote. There are beds of quartz rock stained a dull red by iron, and full of small white quartz threads and veins and green rocks of a fibrous structure, and which contain threads of quartz; both greatly resemble rocks common in the Heathcote district. A fine-grained blue schist, with a rude pencil fracture, occurs at both Dookie and at Heathcote. The rocks on the Saddleback Hill, one mile north from Dookie township, are mostly dolerites and diorites; but there is a small outcrop of talcose schist, very like a rock from a railway cutting at Heathcote, which yielded specimens resembling worm-burrows. Six miles east from Dookie a deposit of calcite has been worked for lime. The mineral appears to have filled a cavity which has been left between bands of rock that have been folded, so as to form an anti-clinal. The process of formation has probably been similar to the formation of anti-clinal reefs at Bendigo; but in this instance calcite has been deposited instead of quartz. The deposit is not being worked for lime at present, there is a lot of unprofitable work to do before the calcite can be obtained, and local residents state that the licence-fee required by the department is excessive. Five miles south-east from Dookie a well has been sunk 170 feet through surface-soil and clay, and through decomposed igneous rock, and a rock resembling decomposed talcose schist. Some clay, said to have been obtained from near the bottom of this well, when assayed by the government analyst, yielded gold at the rate of 13 oz. to the ton. If the clay and gold were obtained from the well, the gold must have come from a decomposed band of the bed-rock, as there are no indications of alluvial strata having been pierced in the well-sinking operations.

NOTES ON THE SITE OF ALLEGED GOLD DISCOVERIES AT GEMBROOK.

(*By James Stirling, Assistant Geological Surveyor.*)

The rock in which the gold is alleged to have been found is a distinctly igneous one, capping the ridge between the Toomuc and Deep creeks. The western watershed of the former creek and portion of the lower levels of the eastern watershed is granite; the country to the east of the igneous rock is Silurian—from the petrographic determination the rock is an ophitic olivine dolerite, and is probably an intrusive mass—erupted along the boundary of the granite and Silurian. The rock is bluish-grey to greyish-black in colour, and weathers into a rich chocolate and reddish soil. Bands of a marly character, simulating bedding, occur in the partly decomposed rock, while the jointings are filled with a kaolinized substance. I was informed that it was principally in this kaolinized substance that the gold was found. From one shaft, 4dwt. 2grs. to the ton; from another, on crest of hill, 5dwt. 13grs.; and from another, at 20 feet from the surface, 4dwt. 2grs. to the ton are said to have been obtained—according to analyses made at the Ballarat School of Mines.

The mode of occurrence of the alleged gold-bearing matrix, which, so far as I am aware, is quite an unusual one, renders it advisable to have further tests made. I would suggest that a sufficient sample of rock be obtained from the site where best analysis is said to have been procured, and a complete quantitative and qualitative analysis made by the government analyst.

The only facts which might tend support to the metalliferous character of such a rock is that afforded by the fact that such important ore bodies as those of the Comstock lode, and many other famous silver mines of the world, have been associated with diabase dykes, which by many petrographers is considered to be only a Pre-tertiary form of dolerite.*

In the absence of further test analysis by the department, I cannot make any recommendations as to further developments.

A well-constructed 10-head battery has been erected close to the edge of the workings. It is stated that the mercury on the tables sickened—thus indicating the probable existence of metallic alloys in the rock.

PETROGRAPHIC NOTES ON SAMPLE OF IGNEOUS ROCK OBTAINED AT SITE OF ALLEGED GOLD DISCOVERIES, GEMBROOK.

(*By James Stirling.*)

Slide No. 4.—A holocrystalline compound of felspar, pyroxene, olivine, and accessory magnetite.

Felspars.—A mesh of well-defined lath-shaped crystals of triclinic felspar, giving labradorite extinction angles, they penetrate the pyroxenes and produce an ophitic structure.

Pyroxene.—The monoclinic pyroxenes occur as large irregular ophitic plates, mainly augite, but in some cases the cleavage suggests diallage, in others, hornblende.

Olivine.—The olivines are well-defined as groups of porphyritic crystals, many under crossed nichols, giving reds of the first order. They do not show much serpentinisation.

Magnetite occurs as irregular-bladed crystals and fragments of octahedra. Titanoferrite occurs in places.

Small crystals resembling zircon also occur in parts of the slide.

There is an almost entire absence of amorphous interstital matter—the rock is, therefore, an ophitic olivine dolerite, and probably forms part of a broad intrusive sheet.

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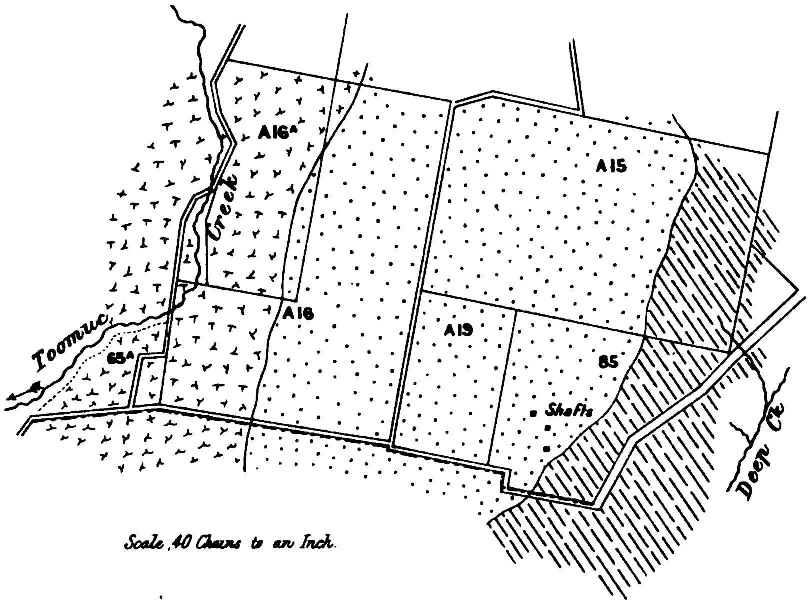
* See Petrographic notes appended.

GOLD DISCOVERIES AT GEMBROOK.

PLAN



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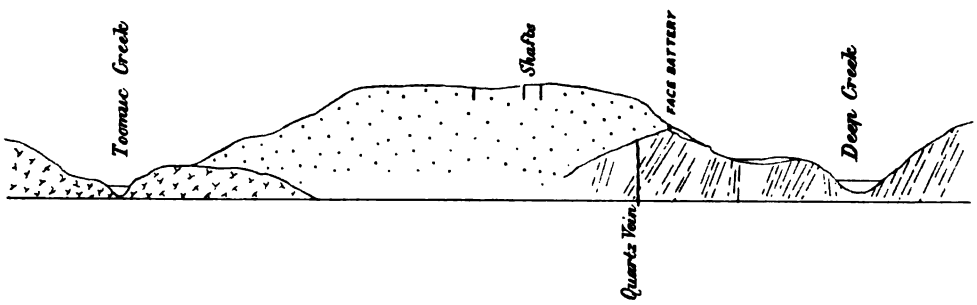

Silurian Sediments ▨ *Igneous Rock (Dolerite)* ⁙ *Granite* ⋏

ADOPTION OF NAME—DOLERITE.

In adopting the name Dolerite for this rock I have been guided by the consensus of the opinion of modern petrographers and geological authorities.

Prof. Rosenbusch employs the term to a coarse-grained variety of basalt of Post-cretaceous age, as subordinate to basalt, and composed essentially of plagioclase, augite, and olivine. *Kalkowski*[1] includes it among the varieties of the family of basalts. *Allport*[2] proposes to raise it to the rank of a group name, that it should be used without reference to geological age, and employed for all basic rocks composed of plagioclase and augite possessing a texture intermediate between gabbro and basalt, olivine not being regarded as an essential constituent. *Teall*[3] adopts Allport's suggestion. *Howitt*[4] remarks that dolerite is only a basalt of coarser structure. *Zirkel*[5] classes dolerite under labrador rocks—this appears to be a very artificial classification. *Mons. Foque et Levey*[6] remark that the structure of rocks composed of plagioclase, augite, and olivine, depends mainly on the rapidity of cooling, synthetic experiments showing that with fairly slow cooling an ophitic structure was produced, with protracted cooling a granular, and with rapid cooling a glassy product (which contained microliths) was obtained.

Johnston[7] has shown that if the specific gravities of the rocks having the same chemical composition is taken into consideration, then the dolerites fall naturally into a group, as follows:—

Tachylite,	2·70	glassy base.
Basalt,	2·90	micro-crystalline.
Dolerite,	2·90	holo-crystalline.
Gabbro,	3·00	„

Prof. Hutton[8] groups the dolerites in his classification of the eruptive rocks of New Zealand under the division, plagioclase rocks—lime magnesia series, micro-granitic texture—and gives the following definition of the dolerite group, as micro-granitic compounds of plagioclase, and augite, enstatite, olivine, and occasionally hornblende. The plagioclase is in laths, sometimes with porphyritic minerals similar to those forming the ground mass, rarely meteoric. The species named is derived from the ferro-magnesian silicates they contain, and varieties by the microscopic structure, as olivine dolerites, augite dolerites, hornblende dolerite, &c.

Prof. Bouney[9] remarks :—"Some authors use the terms dolerite, anamesite, and basalt for rocks which, chemically identical and all holo-crystalline, differ in the coarseness or fineness of their grains, so that the last term is applied to a rock which may be either holo-crystalline or retain a glassy base. It would be convenient, then, to restrict the term dolerite to the holo-crystalline variety, using the epithet coarse-grained or fine-grained as the case might be ; to apply the term anamesite to the lime crystalline varieties, and to include in the term basalt all that retain a glassy base, and the name tachylite to varieties where almost the whole of the material remains in the form of glass."

Prof. Judd[10] in his classic researches on the Tertiary gabbros, dolerites, and basalts of Scotland and Ireland, states that the study of the microscopic structure of these rocks shows :—"That the passage from the granitic type gabbro towards the vitreous type tachylite takes place along two distinct but parallel lines, sometimes the gabbro passes into ophitic dolerite, and this into basalt and magma basalt. . . . . At other times the gabbro passes into granular dolerite, and thence into basalt and magma basalt. The first kind of transition is shown to be characteristic of rock masses which have cooled down with the most perfect internal equilibrium ; the second is found in masses which have been subject to internal movements during consolidation."

Prof. Prestwitch places dolerite under augitic and pyroxenic division of the volcanic rocks, and as a variety of lava. He describes it as intimate, dark-grey, or black compound of augite and labradorite and some titaniferous iron, in which the separate minerals can rarely be distinguished—the ordinary lava of volcanoes—and that there is little or no distinction in mineral composition between dolerite and basalt except that the latter more frequently contains grains of crystals of olivine, has a roughly conchodial fracture, and is generally more massive, homogeneous, and blacker, and is more often columnar. I do not think this classification need be entertained, as the crystallization of the minerals is certainly more distinctive in dolerite than in basalt.

Dr. Geikie[11] classes dolerite as one of the four varieties of basalt (and as the greenstone in part of older authors) in which the component crystals can be readily distinguished with the naked eye. The felspar is usually the most conspicuous ingredient, the dark prisms of augite and dusty magnitite giving the grey or black hue to the rock. The microscopic structure is crystalline, although here and there a small quantity of amorphous base may be traced.

Prof. Green[12] classes dolerite as a micro-crystalline variety of basalt.

Dr. Phillips[13] classes dolerite as the volcanic condition of gabbro among the quartzless plagioclase rocks in which labradorite is predominant. The composition is labradorite and augite, usually with olivine and titanite; in dolerite the grains are distinct, when the grains are fine it is anamesite, if the texture is compact it is basalt, when glassy it is tachylite.

On the whole, as far as my examinations have gone, they are in strict accord with the observations of Prof. Judd, as to the passage from gabbro to basalt—dolerite being an intermediate structure ; while the classification of Kalkowski and the nomenclature therein used is suggested for adoption as the most modern.

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[1] Elements Der Lithologie p. 130.

[2] Q.J.G.S., vol. XXX., p. 529.

[3] British Petrography, p. 136.

[4] Manuscript note to précis of classification, volcanic rocks in Prestwitch geology, 1886.

[5] Zirkel's Petrographie, vol. 1, p. 450.

[6] Structure et classification de roches eruptive, 1889.

[7] The Evolution and Classification of Igneous Rocks. Trans. Edinburgh Geo. Soc., vol. V., part ii., p. 410.

[8] Eruptive Rocks of New Zealand. Ry. Soc., N.S.W., 1889, p. 146.

[9] Anniversary address as President Geo. Sc., London, Q.J.G.S., vol. XLVI., part 3, p. 70.

[10] Q.J.G.S., vol. XIII., p. 87.

[11] Text-book of Geology, p. 147.

[12] Green's Physical Geology, p. 332.

[13] Manual of Geology, p. 40.

REPORT ON THE ALLEGED GOLD DISCOVERY AT GEMBROOK.

(*By R. A. F. Murray, Government Geologist.*)

I beg to report having visited the ground, and concur generally in the views expressed by Mr. Stirling in his report. Whatever be the correct name—mineralogically—of the rock, it certainly belongs to the Older Volcanic, such as occurs in patches and strips of varying extent all through the country south of the main divide from Berwick to the Dargo. I consider the rock in this case to be a flow, or the undenuded portion of a flow, filling in a channel eroded along the line of contact of the granite and the Silurian rocks. It is very likely that wash—possibly auriferous—would be found under this older volcanic rock.

It appears that the resemblance of some of the highly decomposed rock to some of the kaolin ore of Broken Hill first induced the owner of the land (Mr. Rammage) to have some tested for silver.

No silver was found, but the existence of gold in quantity, ranging from 3 dwt. up to 11 dwt. per ton, was reported as the result of various trials of ton samples at the Ballarat School of Mines and several private establishments. These results induced the small company that was formed in consequence to erect a 10-head battery. A quantity of the stone, stated at 70 tons, was put through, and the result was under 1oz. of gold. It was found that the mercury "floured" very badly, and that the escaped floured mercury caught among the blanketings contained gold. Of this I had ocular proof by washing some of the blanketings and evaporating the mercury so saved, when gold was distinctly visible. I could not, however, detect a particle of gold in the stuff washed in the ordinary way, though there were fine specks of a yellow mineral, somewhat resembling gold, but evidently not that metal.

Mr. J. C. Newbery's assay of a quantity of the rock sent to him some time ago gave a "trace," but it is admittedly uncertain whether such "trace" of gold was actually produced from the rock or found its way into the assay accidentally—a circumstance apt to occur in spite of the greatest care in a laboratory where other assays of, perhaps, richly auriferous minerals are or have been recently in progress.

The discovery of gold in the bulk trials made at the Ballarat School of Mines and elsewhere I am not prepared to explain, but, with respect to the battery results obtained on the ground, it appears that the silvered plates bought with the battery had been in use previously elsewhere, and that some of the mercury had also been bought with them.

The mercury on the plates, and also that in stock, presented appearances which I learned at the laboratory are probably due to the presence of zinc, an adulterant difficult to separate, even by distillation, and which accounts for the "flouring," there being nothing in the rock to cause it. It appears very likely, therefore, that the gold actually obtained may have been previously on the plates; for were the stuff as auriferous as represented by the result of the Ballarat trials, more gold would have been saved from the quantity of stone crushed on the ground, even taking into consideration the manifest defects of the battery appliances and the bad quality of the mercury used.

Although the occurrence of gold in such rock is not impossible, from a geological point of view, it is so far practically unknown, and proof of it would be an interesting scientific discovery. So far, I have seen nothing to induce me to believe that gold exists in the rock at all, and must, therefore, assume that to some error or want of care are due the—in such cases—misleading results furnished by the Ballarat School of Mines, which caused the company to incur the expense of purchasing and erecting a battery. Should this assumption prove correct on the evidence of further trials, it will be a matter of regret that such a mistake should have been made in a public institution of the high character claimed by the Ballarat School of Mines. If proved, this will be the second serious mistake of the character which it has been my unpleasant duty to record; the first being in connexion with trials of stone from Glen Thomson two years ago (Quarterly Report 31/12/90, page 45). Another sample, collected by myself, of the stone from Gembrook has been sent for assay by Mr. Newbery; also some of the blanketings containing the floured mercury for separation of the latter, and test for free gold of the residue.*

REPORT ON THE TAWONGA GOLD-FIELD.

(*By Ernest Lidgey, Assistant Geological Surveyor.*)

The Tawonga gold-field is situated on the eastern slope of the Dividing Range between the Ovens and Kiewa rivers, in the parish of Mullindolingong, extending to the north as far as Deep Creek, and south into the parish of Freeburgh.

The surface rock is a metamorphic sandstone, in some places very ferruginous, soft, and easily worked, requiring very little blasting. In sinking No. 2 shaft, in the California, the sandstone was passed through, and a hard silicious slate was entered, containing numerous white quartz veins, carrying gold, iron pyrites, copper pyrites, and small pieces of native copper in the form of dendrites.

The metamorphic rocks of the range pass beneath the Kiewa Tertiaries, on the east, which cover the valley for a width of about a mile and a half.

Two lines of reef have been opened, and both traced for a distance of about a mile, parallel to one another. The Spark line, having a strike nearly north and south, with an underlie of 28°, on which very little work has been done, and Morrison's line of reef, on which the strike varies from N. 5° E. and S. 5° W. to N. 5° W. and S. 5° E. The underlie varies from 14° to 45° to the west.

At the time of my visit there were only three claims at work on the field, these being all on Morrison's line of reef, and are the Star of the West, the California, and the Consolation, all on private property, being portion of a lease held by Mrs. Higginson, shown on the map of Bogong as grazing block 28.

The reefs vary from a tough vitreous quartz, containing very little gold, to a friable honeycomb quartz, easily crushed, and containing a fair percentage of gold.

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* The results of these trials have since confirmed the opinion expressed above.

Tawonga may be reached by a bridle-track from Bright (distance 14 miles), which passes through the present workings. A road has also been surveyed near this track, which will probably be commenced during the present year. The only dray road at present is *viâ* Yackandandah, distance about 40 miles.

There is plenty of timber on the field suitable for mining purpose, and water could be obtained in almost unlimited quantities from the Kiewa River all the year round, whilst in the winter a fair supply could be found in the gullies traversing the field.

There is a 4-head battery close to the claims, worked by a Robey's portable engine, for which water is obtained from a gully, but which is idle during the summer months.

The Dead Cow is the name of the first claim which was pegged out, and was worked by the original prospector of the field, Mr. Morrison. This is the most southerly of the workings on Morrison's line of reef. A shaft has been sunk about 40 feet, and a drive put into the north for a short distance, but owing to the presence of water in the workings could not be inspected. The shoot of gold is stated to have pitched to the north. The trial crushing gave a return of 6 (six) dwts. per ton. No work is being done in this claim.

The Welcome North is the next claim, and is owned by Messrs. T. Robinson, T. Hollands, and R. Howman. Seventeen tons of stone crushed at the battery gave 6oz. 12dwt. retorted gold, an average of nearly 8dwt. per ton.

The Star of the West, owned and worked by Walker Bros. (3) and Robson, is the next on the "line." A tunnel was driven on the reef for 34 feet, when a fault was met with, entirely cutting the reef off. The fault is nearly vertical, striking east and west. A shaft was then sunk for 74 feet, fair stone being obtained all the way down. The reef averaged about 9 inches, but pinched out in places to a mere thread. At 74 feet a drive was put in on the reef to the south for 15 feet, but the air proving very bad, this was discontinued, and a new shaft sunk at 85 feet south of No. 1 shaft. This shaft has been sunk on the underlie of the reef to a depth of 92 feet, gold being obtained from the reef all the way down. The reef in this shaft is from 6 inches to 12 inches wide, and has averaged 16dwt. of gold per ton. At the bottom of the shaft a drive was put in to the south for 25 feet, and then stoped up to the 50-ft. level. Here a drive has been commenced to the north to connect with No. 1 shaft. A drive has also been started in No. 1 shaft to connect with that in No. 2.

The California is to the north of the Star of the West, and is worked by Mr. Howman and a boy. Two shafts have been sunk on this claim. No. 1 shaft was sunk 32 feet on the underlie of the reef W. 5° N. 20°. The reef varied from 12 inches to a mere thread in width—the shoot of gold pitching south. No. 2 is down at present 45 feet, where the country rock changes from a decomposed metamorphic sandstone to a hard silicious slate, traversed by innumerable quartz veins containing iron pyrites, copper pyrites, and native copper. Here water interfered with the work, and nothing is now being done at the bottom of the shaft. The stone crushed from the California averaged 6dwt. per ton.

The Consolation is situated to the north of the California, and is owned and worked by Mr. Abbott and a boy. Three shafts have been sunk on this property. No. 1 to a depth of 52 feet on the underlie of the reef at an angle of 45°. At the 30-ft. level a drive was put in for a distance of 30 feet to the north, when the reef pinched out. At the foot of the shaft the reef is about 10 inches thick, but carries very little gold. No. 2 shaft was sunk for 30 feet, and a drive put through to No. 1 shaft, the ground then being stoped to within 10 feet of the surface. No. 3 shaft is down 20 feet, but the reef carries very little gold.

The Carbine is the last claim on this line of reef, but has been abandoned. It is stated that the first crushing from here returned 6dwt. per ton, and that a second crushing gave 1oz. 5dwt. per ton.

The Spark line of reef is parallel to Morrison's, and about 6 chains west of it, the surface being from 300 feet to 500 feet higher up the hill. Several trenches have been opened on the reef, and a short tunnel driven, from which a few tons were crushed, giving a return of 6dwt. per ton.

A little sluicing for alluvial gold has been done at the junction of Deep Creek with the Kiewa River, but did not prove payable.

NOTES ON AURIFEROUS QUARTZ VEINS.—ROKEBY DISTRICT.

(*By James Stirling, Assistant Geological Surveyor.*)

Alluvial gold having been obtained in a tributary of Pilgrim Creek, about 8 chains north of Old Gippsland-road, or about 40 chains west of Jackson's 20-acre allotment, subsequent prospecting on the adjoining ranges disclosed the existence of auriferous quartz veins. The alluvial wash consists of surface soil, clays, and gravels 3ft. 11in. deep, yielding ½ dwt. of fine gold to the ton. This wash has been followed down the creek for 30 chains to junction with Pilgrim Creek and along the latter to lower levels for about 2½ miles, and varies in depth.

The Enterprise Reef.—To the south of the creek the Messrs. Harris have opened out a quartz vein by systematic trenching in the locality. This is known as the Enterprise. It is in curly greyish Silurian slate, slightly metamorphosed, and underlies but slightly to the east. In sinking the shaft two leaders were cut entering the main body of stone from the east—the first was 5 inches thick. A small drive put in at the 30-ft. level disclosed the main body of stone as 3 feet in thickness, carrying a little gold. The strike of reef is nearly north and south, and it is well defined to the depth attained in shaft, viz., 42 feet, where another small drive has been put in to the west, showing the junction of another leader carrying gold. (See sketch section.)

From samples of quartz on the mullock heaps I obtained several pieces carrying fine samples of gold, although on crushing and panning of samples from the 32-ft. level I failed to get colours.

An analysis obtained by Mr. Harris was shown me from the Ballarat School of Mines. According to this assay samples gave 2dwt. 15gr. of gold and 6 dwt. of silver per ton of sample, and another

1dwt. 23gr. of gold per ton. About 200 yards up creek from Harris' shaft, another reef has been exposed on opposite side of creek. Here the reef underlies about 12° to the east. Outcrop has been traced from hill-side towards creek.

Golden Crown.—On same line of strike to north of the Enterprise other quartz veins have been discovered, and are being tested. The Golden Crown where visible inside of shaft is 13 feet thick, and is moderately well defined to the depth of 20 feet. It appears to be associated with a felsitic dyke, which is more distinct in the Wilson's reef to the north. Fine spangles of gold were observed in the ferruginous quartz occurring in the reef.

Wilson's Reef.—About 20 chains north of Golden Crown. Several shafts have been sunk on a reef formation associated with felsitic dykes from the rock excavated. The mode of occurrence of the reef is somewhat peculiar as regards the geological conditions under which it occurs. I was, in the absence of the manager, unable to descend the shaft to view the workings, but I should not be surprised to know that rich patches of auriferous quartz have been found in association with the felsitic rock. The conditions do not preclude such discoveries.

General Remarks.

From the mode of occurrence of the above-named reef formations and the character of the associated strata, there is a probability of richer stone being obtained along the auriferous belt to the south. Although in proximity to the dyke formation the yield may be variable, and the shoots of gold, although rich, less defined than where the auriferous matrices form well-defined quartz reefs.

To the south the Silurian sediments disappear beneath the Tertiary volcanic soils, clays, and underlying conglomerates towards Warragul; and south of Warragul probably underlie the Jurassic formations of McDonald's Track.

Tertiary Auriferous Drifts.

Samples of drift obtained in Bear Creek by Mr. Chaffey were shown to me. This wash, consisting of milky-white quartz gravels and fine felspathic clays and grit, resembles the sub-basaltic washes of the Moondarra Plateau.

Similar deposits to those of Bear Creek may be traced along the margin of the Jurassic spurs at intervals towards Trafalgar.

The character of the wash varies in different localities. It is most probably auriferous in those places where the drift has been deposited in cavities, where eddies have formed during transportation of the drifts along the base of the range. These auriferous gravels are evidently derived from the denudation and abrasion of the Silurian rocks to the north during the erosion of the old valley along the line of contact of the latter with the younger Jurassic beds, and probably prior to the volcanic accumulations of the Latrobe Valley.

REPORT ON THE DART RIVER AND ZULU CREEK GOLD-FIELD.

(*By R. A. F. Murray, F.G.S., Government Geologist.*)

I have the honour to submit a report on the Dart River and Zulu Creek Gold-field, of which I have recently made an inspection, and towards which, after several years of comparative neglect, enterprise is again being directed with fair promise of success. The principal route from Melbourne to the Dart River is by rail up to Tallangatta, thence by a very good vehicle road up the valley of the Tallangatta Creek as far as Cravensville, 28 miles from Tallangatta.

From Cravensville to the Dart River, a distance of 18 or 20 miles, all conveyance is by pack-horse along a good but in places steep bridle track, the original difficulties of which have been greatly modified by sideling cuttings. This track ascends continuously from Cravensville to the main dividing spur, between the Murray and Mitta Rivers, follows that spur for some miles and then descends a branch spur into the valley of the Dart, which is an eastern tributary of the Mitta. The track from the Dart River to Zulu again rises to the main spur, follows it for a short distance and then descends a steep rugged spur into Zulu Creek, which is tributary to the Murray.

The prevailing rocks of the gold-field are Silurian (apparently Lower Silurian) of the ordinary character, exhibiting but little metamorphism.

A granitic area fringed with metamorphic schists is crossed between Cravensville and the Dart, and another outcrop appears on the track easterly towards Corryong.

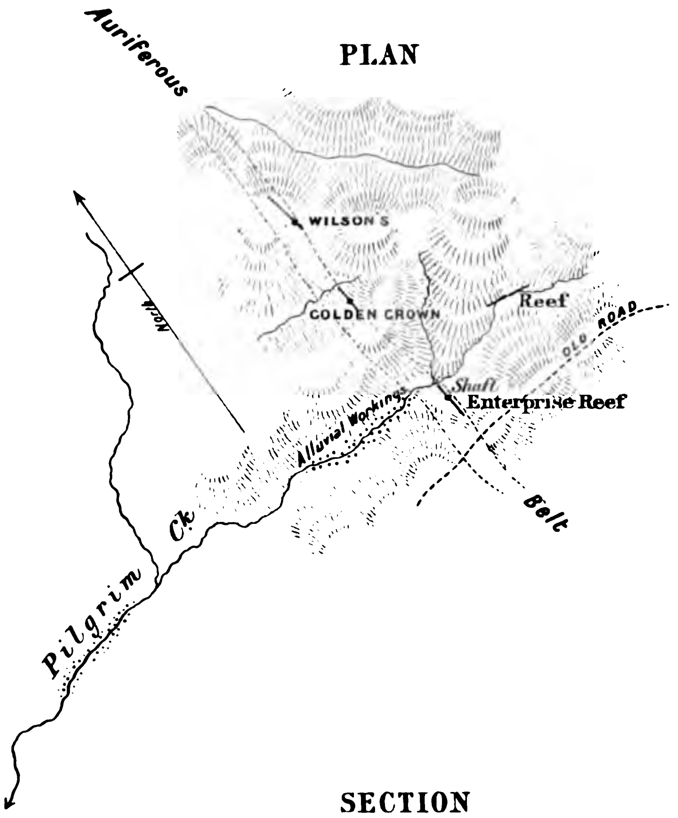
When the field was opened, some nine years ago, there was considerable excitement in consequence of the rich yields obtained, and very sanguine anticipations were indulged in; but it was found that, like those of Bethanga, the lodes only yielded their gold freely where decomposed near the surface, and that beyond the limits of decomposition the available methods of treatment were insufficient to extract the gold from the highly mineralized stone, the bulk of the metal simply running away with the pyrites. An impression also obtained that the ore was as intractable as that of the Bethanga lodes, to treat which so many determined but unsuccessful efforts have been made.

So far as is at present known the lodes of the Dart River and Zulu Creek occupy a belt some 10 miles in length and about 3 miles in width, the longitudinal extensions of which either way have however been very little prospected. As a rule the lodes coincide with the containing Silurian strata, having a general N.N.W. strike and in nearly all cases an underlay to the E.N.E.

Though not of very great thickness they seem to be fairly persistent, many of them having been traced for miles, alternately opening out into "shoots" of various dimensions and pinching to mere "tracks."

REEFS AT ROKEBY

PLAN



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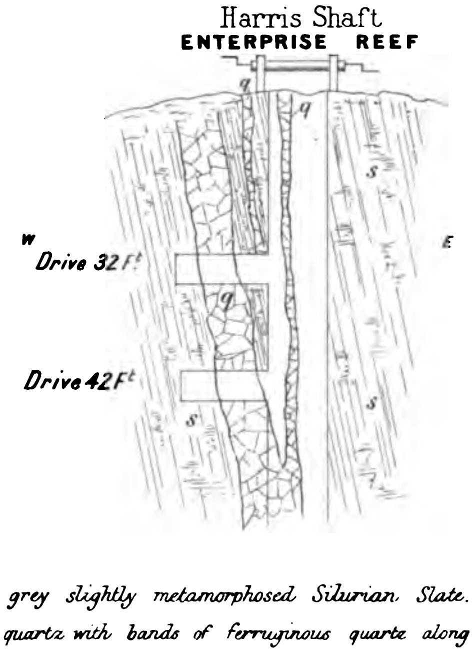


s Curly grey slightly metamorphosed Silurian Slate.
q Glassy quartz with bands of ferruginous quartz along margin (casing)

[illegible]

At surface the ore is very gossany, consisting of very honeycombed quartz and iron oxide, but at a short depth below the surface, sometimes only a few feet, this passes into highly pyritous quartz or even pure iron pyrites. In the case of the gossany ore the decomposition of the pyrites naturally has set the gold free and enabled it to be saved by means of ordinary appliances, but the undecomposed mineral requires special treatment, the appliances for which have yet to be introduced on the field. Unlike the Bethanga lodes, however, there is a noticeable absence of copper pyrites, arsenical pyrites, and other minerals tending to render treatment difficult.

Only in one case did I notice traces of copper and in a few a little galena, but as a whole the ores may be regarded as easily amenable to the ordinary processes for treatment of iron pyrites, and offering none of the serious difficulties presented by the Bethanga ores.

The following condensed notes will serve to describe the main features of the various lodes visited :—

Alpine Star Lode.—Excavation showing lode 8 feet wide between well-defined walls. Underlay E.N.E. Gossany, honeycombed quartz passing into pyritous quartz, and occasionally massive pyrites proved for about a quarter of a mile, with payable prospects. Stated yields from surface crushings, 1 oz. per ton, the pyrites being lost. Parallel lode to westward of Alpine Star traced by surface excavations for a long distance, proved auriferous, but no crushings taken; about 4 feet thick, and composed of mixed gossany, quartz, and slaty bands.

Proceeding south-south-easterly, a large outcrop of quartz appears at the foot of a spur on the approximate line of the Alpine Star lode, and there has also been worked near the surface a reef running east by north, and turning with a sharp curve to N.N.E.; thickness, about 2 feet; stated yields, 14 dwts. per ton.

Further south is another reef, known as the Lyre Bird, running nearly north and south.

The Glengarry Reef.—Sheehan's Creek, a branch of the Dart River. Tunnel workings show width of lode up to 10 feet, bearing N. 10° W. to north-west; underlay in south face to north-east at 43°, but getting more vertical downwards; good-looking stone, with large proportion of pyrites; 14 tons treated at Footscray stated to have yielded 41 ozs. of gold.

About 300 yards eastward of the Glengarry is another line, opened at a few places and found auriferous; traced over half-a-mile bearing N.N.W. and S.S.E.; principally ironstone, gossany, and quartz.

The Dark River Reef.—Close to township. Worked by tunnel. Similar to the Glengarry, but showing traces of copper and galena.

Westward, apparently, of the Glengarry are the Clara, up to 5 feet in thickness, and Kelly's Reefs, about 120 feet westward. Worked down to the undecomposed mineral. Former crushings yielded up to 10 ozs. per ton.

The Mermaid Line.—Westward of Kelly's, bearing N.N.W. Worked some 200 feet in length; up to 5 feet in width; down to mineral at 75 feet. Yielded 1 oz. per ton all through.

The Federation.—On Old Mascotte Line. Stated to be traceable for nearly 5 miles in length; also worked with good results down to the undecomposed mineral. Lode bearing from N. to N.N.W. Underlay easterly, alternately widening and pinching from a few inches to 3 feet. Value of some of the ore at grass is estimated at 6 ozs. per ton. Similar general features in the Eureka mine on same line.

This line is occasionally intersected by dykes of soft felspathic rock, some of which do not fault the lode, others only slightly.

The Homeward Bound, Hidden Treasure, and Turn-To lines exhibit the same general features as the other lodes. The Turn-To tunnel, in the United Miners' ground, intersects the "track" of the Hidden Treasure lode, besides several other "tracks," and reaches the Turn-To line, which bears from N. to N.N.W., and is a fine well-mineralized lode, from 18 to 30 inches thick.

To the southward the Hidden Treasure is being worked by Messrs. Aston and Madina, and is taken out to a thickness of 18 inches; it is accompanied by a soft felspathic dyke which forms one wall. The decomposed ore is very rich in visible gold, which can also be seen in the mineralized stone. Mr. Aston informed me that he receives £12 10s. per ton for the mineralized ore, hand sorted, at the shaft, the purchaser having to pack it down to Cravensville and thence cart it to the railway line.

At Zulu Creek the Just-in-Time lode is being worked by Messrs. Bolton and Gillies, who have proved it right across the creek bed.

In the tunnel on the north side the lode is from 2 to 5 feet wide, highly mineralized, and occcasionally nearly pure pyrites with some galena. On the south side of the creek an excavation shows a total width of 5 feet, of which 18 inches on the eastern or hanging wall is nearly pure pyrites, estimated as worth 10 ozs. of gold per ton; the remainder is mineralized quartz and slate, also auriferous.

Southward on this line is the Umslopogaas mine, the workings of which show a persistent lode alternately widening and pinching, and showing good mineralized stone.

The above-mentioned reefs constitute only a portion of those proved on the field. There are numerous old mines showing stopes down to the mineralized stone which would certainly not have been worked had they not yielded, from the decomposed portions of the lodes, sufficient to pay the cost of mining and packing to the battery, and from all I saw the following conclusions appear justifiable :—1st. That the ores of the Dark River lodes are not of a specially intractable character, and that all that is required to make them remunerative is the presence of suitable appliances on the ground. 2nd. That there is no reason to doubt the downward continuance of the lodes to great depths. 3rd. That there are no visible grounds whatever for the fear which some entertain that the ores will become more intractable with increasing depth. 4th. That there is scope for the profitable employment of a large mining population.

The great present essential to the success of the field is a good vehicle road, which I am informed can be made at a cost of about £3,000, and would assist in the development of mining and opening up means of employment more than a railway would in many other more accessible localities.

NOTES ON THE FOSTER GOLD-FIELD AND DISTRICT.

(*By James Stirling, Assistant Geological Surveyor.*)

In introductory remarks to this report it is pointed out that the Foster district presents features of geological and economic importance, as in close proximity are Silurian and Jurassic rocks, the former yielding auriferous materials, and the latter containing coal seams.

Alluvial auriferous deposits in proximity to auriferous quartz veins, the latter associated with intrusive Plutonic rock (granitic dykes).

ALLUVIAL.

Like other gold-fields in Victoria, the discovery of alluvial gold (during 1870 at this place) led up to the search for and discovery of auriferous quartz intersecting the Silurian bed-rock.

The alluvial deposits immediately surrounding a small hillock known as Kaffir's Hill seem to have yielded the richest deposits. The auriferous gravels may be said to comprise two classes of deposit; the older found capping the low foot-hills, and the younger forming the so-called leads at lower levels. The lead (if lead it may be called) seems to have been traced from the flanks of a ridge running northerly from Kaffir's Hill, about 6 (six) chains distant, attaining in one place a depth of 60 feet, the wash-dirt occurring in irregular deposits; the richest portions being worked in narrow gutters, flat shelves, or patches.

It is stated that 500oz. of gold was obtained in one of the drives, and in another, of 160 feet, an average of 120oz. to the set of timber was obtained. The deepest ground yielded more specimen gold, and the upper portion finer waterworn gold, as if the former had been derived from the disintegration of quartz veins *in situ*, while the latter had been subjected to a considerable amount of subaqueous attrition. The alluvial auriferous belt is, approximately, half-a-mile wide.

The age of the hill gravels has been classed as Pliocene; some lignite and fossil fruit, resembling those of the Haddon leads, have been obtained in the deeper portions of the wash, while the alluvial deposits in the creek flats are classed as Pleistocene.

QUARTZ VEINS.

About a chain west of the summit of the Kaffir's Hill, a granite dyke traverses the Silurian strata, metamorphosing in places the argillaceous slates near the contact into silky or satiny somewhat micaceous schist. This granite dyke seems to be an apophysis from the granite of Doughboy Island, in Corner Inlet, to the south. It is a ternary compound of orthoclase, muscorite, and quartz. Auriferous quartz veins occur in the dyke as well as in the contiguous strata, as represented in diagram No. 1. It has been held by practical miners that the disturbed and broken character of the strata and quartz veins at contact indicate a breaking of the strata and associated quartz veins by the dyke subsequent to the formation of the quartz veins. The opening up and exploration of quartz vein in No. 1 South claim to a depth of 185 feet, crossing the dyke, seems tolerably conclusive evidence that the auriferous quartz veins are probably associated with the intrusion of the dyke into the Silurian, or are contemporaneous.

The following notes on several of the claims are recorded :—

African Co-operative Company.—Worked with profit a vein 12 to 18 inches wide east of the Granite Bar down to water level.

Granite Bar.—A small vein 3 to 8 inches thick yielded 4oz. to the ton; was worked to contact with dykes.

No. 1 *South.*—A vein from 6 inches to 2 feet gave from 1 to 7oz. per ton. A considerable quantity of loose rubble connected with this lode was crushed. The mine appears to have suffered by the defective machinery and management.

The Prussians No. 1 *and* 2.—Veins from 4 to 10 inches wide were worked to a depth of 87 feet, averaging 10oz. per ton. Rich deposits of gold were found close to the hanging wall in nests or pockets, encased between indurated wall rocks ; are stated to have yielded 2, 4, and 6oz. pieces, and from 100 to 500oz. of gold. When the leaders entered harder strata, the stone became glassy and poor.

Ophir Reef, situate to the north of Kaffir's Hill, is from 1 to 5 feet in width. A shaft was sunk to a depth of 150 feet, and the yield was from ½ to 1½oz. per ton. Claim also known as Jubilee Gold Mining Company.

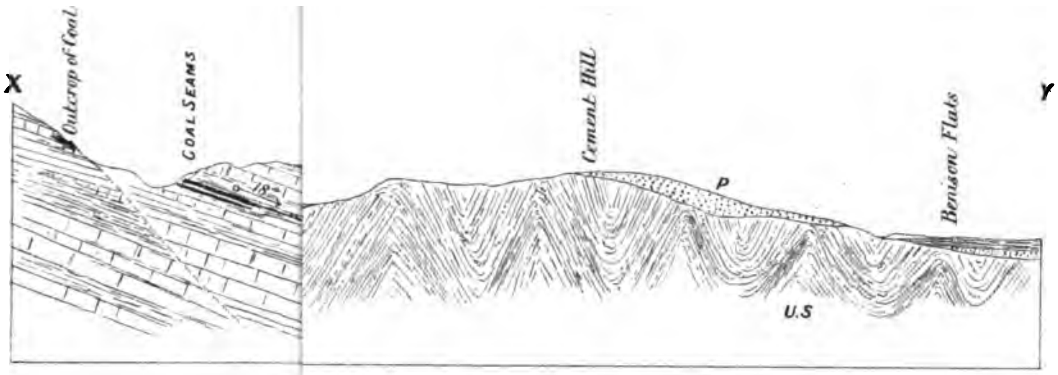
Gladstone Company.—This now embraces the lodes known as Old Man's reef and the Prussians, mentioned above. A shaft has been sunk at the base of Kaffir's Hill, and carried to a depth of 210 feet. The strata was observed to break at intervals of 40 feet. Cross slides and courses were met with 30 feet from face, running at an angle of 45°. The lode appears to have been very irregular, the quartz glassy, and charged with pyrites, occurring in patches and nests. A cross-cut put in at 170 feet cut small veins, but no gold. It is stated that Northy first found gold in the Old Man claim in 1870.

Jubilee is being worked by a shaft from summit of Kaffir's Hill to a depth of 200 feet. Drives were put in at 190-ft. level, 90 feet to west and 190 feet to south ; a well-defined lode 5 inches wide, carrying gold; the last crushing yielding 3oz. to the ton for 70 tons crushed. The load stuff is in parts highly charged with iron pyrites, sulphide of lead (galena), and cuprec carbonates and sulphides. At a point in drive where the adjoining Victory Company broke into the workings, the features shown in diagram No. 2 are seen ; here the lode occupies the lower portion of a band of crushed stratum in the vicinity of a slide or fault, and at another portion of drive the features shown in No. 3. The nearly vertical slates, with interbedded indurated bands above the load (which is nearly flat at this point), are less highly inclined below the foot-wall. The lower part of the lode is heavily charged with viridite, a hydrous silicate of alumina, magnesia, and ferrous oxide, or a decomposition product allied to chlorite or serpentine.

The Victory Company (amalgamated leases).—In driving from their shaft this company cut the reef known as Irwin's at the 200-ft. level. Though attenuated in the drive, the load is reported to have widened, and from parts of it exceedingly rich quartz was obtained.

When a detailed geological survey of this gold-field has been obtained, it may be possible to generalize as to the direction in which further mining developments should take place. As stated in report on the Toora Tin Mines, the stretch of country which embraces the former, the Foster gold-field, and Waratah Bay silver deposits, as occurring along the margin of the southern edge of the Gippsland carbonaceous formation is well worthy of detailed geological investigations.

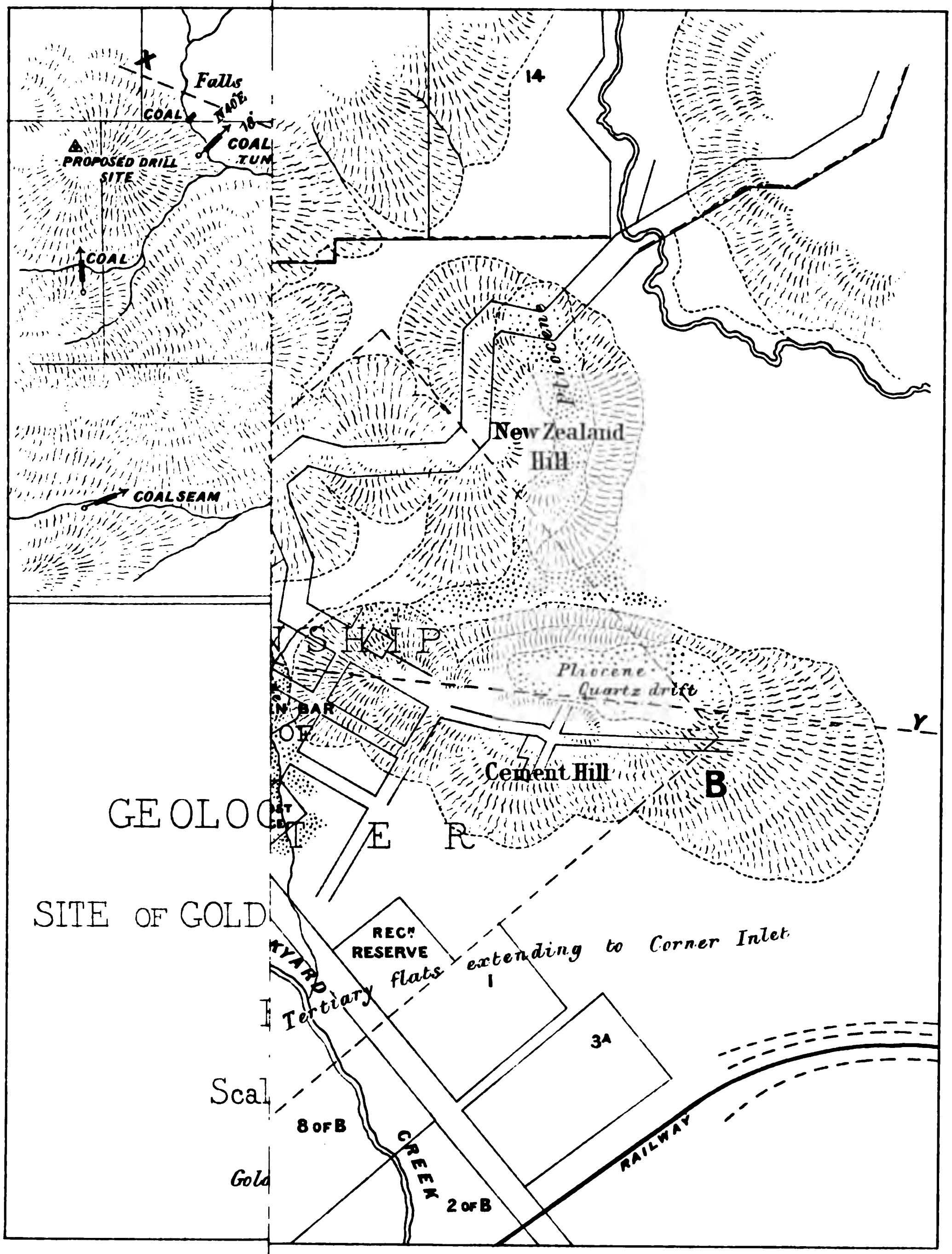
ARD C^{K} VALLEY



ys. C Granite Dyke. (Q.V Auriferous Quartz Veins)

NOTE. The boundary
Silurian is o

Horizontal Scale. 20 Chains to an Inch.



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REPORT ON THE AURIFEROUS COUNTRY IN THE NEIGHBOURHOOD OF QUEENSTOWN.

(By R. A. F. Murray, F.G.S., Government Geologist.)

I beg herewith to submit a report on a brief inspection of the reefing country around Queenstown (the old Caledonia diggings) and adjacent localities. On my way thither I diverged to Greensborough, to look at an auriferous cement deposit—recently opened up by Mr. Samuel Cutts, of Ringwood—on the eastern bank of the Plenty River. The bed rock is Upper Silurian, and at an elevation of about 100 feet above the river this is capped by considerable deposits of quartz, gravel, sand, and very hard ferruginous conglomerate, apparently passing under a small basaltic area to the eastward. The workings so far consist of a few holes and excavations near the edge of the deposit close to where the Silurian rock appears beneath it, and very little has yet been done to prove which are the best portions, or whether the gravel and cement have any defined trend, but from the various specimens shown me it is evident that there is a fair amount of gold distributed through the cement, as a great many pieces contain visible fine but solid specks of gold, and several dish prospects of the loose gravel gave small prospects. The payable character of the cement is simply a matter for practical experiment, and Mr. Cutts is having a parcel of several tons treated at the Otis works, on the result of which will depend the continuance of operations. A very moderate average yield should be remunerative in view of the easy way in which the cement can be taken out and the local facilities for erection of battery, water supply, &c., provided the land-owners are not too exacting, and—as is often the case—excessive compensation is not adjudged by the warden who may deal with the lease application.

Proceeding along the road to Queenstown the first gold-field passed is that near Eltham, where several gullies were turned over with good results many years ago, and a few fossickers are still at work. As far as I could learn the reef or reefs forming the sources of this alluvial gold have not yet been discovered.

Further on the road passes through Kangaroo Ground, where there is a basaltic area under which auriferous drifts are said to have been traced, but not extensively worked. There appears to be here a good field for prospecting by tunnelling if the private property difficulty could be satisfactorily adjusted.

A few miles beyond Kangaroo Ground is Panton Hill, where reefing has been highly successful in the past and recent discoveries have been of a very encouraging character, and in the same belt of country two or three miles further to the northward is Queenstown, where the Caledonia Creek and numerous tributaries were worked with rich results nearly 40 years ago, and a number of men are now fossicking out a living.

It was to the reefs in this vicinity that I was able to pay most attention during the brief visit made, the inspection embracing those near Queenstown, and those at Yow Yow and One Tree Hill to the eastward.

Close to Queenstown, in the ground now held by the Eastern Star Company, is the Queenstown Reef, having a north-westerly strike and south-westerly underlay, which is met by the St. Andrew's Reef, which strikes north north-easterly *with* the country rock, and underlies to the W.N.W. Though regarded as two reefs, these appear to me to be the same lode having a flexure in its course, though the opinion could not be verified at the time of visit. The old stopes show a width of 3 to 4 feet, and the reefs have been worked to from 65 to 80 feet, by all accounts with very rich yields. A main perpendicular shaft is being sunk to command the lode or lodes at greater depth on the underlay. A little further back along the road towards Panton Hill is the Jenny Lind Reef striking N.N.E. and worked for about a quarter of a mile in places to as much as 100 feet. A tunnel driven in from the hill side shows strata dipping easterly, flatly near the entrance but more vertically further in near what appears to be the continuation of the lode which has merely been cut, and is here 6 to 9 inches thick, with an underlay to the W.N.W.

Another lode somewhat eastward has been worked a little further south to about 90 feet, and is stated to have been rich.

Two parallel reefs, striking E.N.E. and underlying N.N.W., start from about the end of the last-mentioned lode and cross the Jenny Lind Gully, which was very rich, and was worked right up to the road. These two reefs are said to have been followed down to about 100 feet with good results. The old stopes show a width of 3 feet. Alongside of Jenny Lind Gully, on the western bank, are old reef workings bearing N.N.E., the strata apparently underlying eastward, and the reef westward—old stopes about 3 feet wide. No definite information was obtainable about this line, but the amount of work done indicates that it must have been payable. Portion of this ground is being fenced in by a selector. The strike of the Silurian rocks in Caledonia Creek, near the junction of Jenny Lind Gully, is N.N.E., and the dip E.S.E. On the range eastward of Caledonia Creek is Cameron's reef, and another parallel one 100 feet southward, both of which have been a little worked.

The next place visited was Yow Yow, a mile or two eastward of Queenstown, where, in the ground of the Reliance G. M. Co., are five distinct reefs, known respectively as No. 5 Reef, Hirtz Reef, Murray's Reef, Allan's Reef, and Eureka Reef. All of these have been worked for considerable distances, and, by the accounts given, yielded very well in the past. An apparent continuation of the No. 5 to the northward has been stoped for a width of 12 feet in or near the Otis Company's ground, while another reef, the Comet, apparently a continuation of Allan's Reef, runs into a mass of intrusive diorite, about 200 acres in extent, known as the Nobs. The Eureka Reef also runs into this diorite, and a shaft is being sunk on the diorite by the Defiance Company. It appears that these reefs pass from Silurian rocks into the diorite and thence on into Silurian rocks again.

From the main mass of diorite a great dyke passes southward, and with it are also associated the Hirtz and Murray lines of reef, though it was impracticable to gather the exact relations. All these reefs have a north-easterly strike, and the greatest stated depth to which they have been worked is about 200 feet, while yields up to 40 ozs. of gold per ton are said to have been obtained. A tunnel has been driven from the creek level some 900 or 1,000 feet, partly through Silurian rock and partly through diorite, to work some of these reefs, but it was impracticable to ascertain what work had actually been done in the stopes above. This tunnel may be of use in future, as an adit for drainage and trucking, but a shaft would have afforded a more efficient means of working the ground. The present holders are adopting this course.

Some of the reefs, the Comet line and the Hirtz line, contain rich antimony ore.

Eastward from Yow Yow is the One Tree Hill range, where there are three lines of reef in the ground held by the One Tree Hill G. M. Co. These are known as the Big Reef, the Moonlight Reef, and the Swedish Reef. All are reported to have yielded well, especially the last, which is said to have contained some phenomenally rich stone.

A tunnel from the level of a deep gully commands all these reefs, and a good deal of stoping has been done above it, but, if extended, a good height of backs would be commanded along the extensions of the lines, especially the Swedish Reef, which has been cut and only followed a few feet northward, though improving in appearance in that direction. A short distance further driving would probably catch the downward continuation of the rich shoot worked above.

The reefs continue strongly downward beneath the tunnel, and any future extensive workings will have to be carried out by means of a main shaft.

From the top of the One Tree Hill range a view can be had to Warrandyte and Ringwood, bearing about S.S.E the line passing close to Kangaroo Ground. This is the general strike of the Silurian rocks in the district, and of the Anticlinal fold in those rocks along which, at Warrandyte and Anderson's Creek, the principal gold discoveries have been made.

The general conclusion arrived at is that there is a fairly well marked auriferous belt of Silurian rocks extending from Ringwood through Warrandyte, Kangaroo Ground, Panton Hill, and Queenstown to Kinglake (Pheasant Creek), and probably much farther. This belt is several miles wide, and along it at intervals many discoveries of alluvial gold and richly auriferous quartz reefs have been made in the past, those above mentioned being only a small proportion of what have been found.

In many cases the history of these reefs has been lost, but there is every inducement towards re-opening and tracing them deeper, besides the chance of others as yet untouched.

As soon as practicable it would be most advisable to make a detailed geological and topographical survey of the area, which, from its proximity to Melbourne and its many natural advantages, is well deserving of close attention.

NOTES ON THE SILVER DEPOSITS AND LIMESTONE BEDS OF WARATAH BAY.

(*By James Stirling, Assistant Geological Surveyor.*)

The existence of silver-bearing lodes having been reported as occurring in the Waratah Bay district, an inspection was made, and the following notes recorded on the geological features between the limestone quarries and Point Grinder :—

TERTIARY.

Capping the Palæozoic rocks exposed along the coast are deposits 200 feet thick of gravels (in parts auriferous), conglomerates, and quartzites. These beds cover the whole of the head-land towards Cape Liptrap. Near the shore they have been sluiced for gold. The white quartzites resemble the beds of similar composition which underlie the volcanic clays and basalts of the Tarwin Valley to the north. They are probably later Miocene or early Pliocene, or may be passage beds. (See sketch section No. 1.)

SILURIAN.

The limestone beds outcropping at the quarries and also at Bird Rock, Bell Rock, and Point Grinder, (see locality plan), and which vary from hard bluish-grey normal limestones to greyish-white marbles, appear to occupy basins or form lenticular-shaped deposits in the Silurian sedimentary rocks, although flexured and contorted over considerable areas. (See sketch of Bell Rock.) The induration of the limestone beds or conversion into marble—as at Point Grinder—is due evidently to the intrusion of plutonic rocks to the east. From the limestone resting on grits and agglomerate beds near the jetty and dipping to S.E. a number of fossils, bivalves, univalves, and corralines, of an Upper Silurian facies, were obtained. At this place the sedimentary rocks rest unconformably under hard felsitic rocks. (See sketch Waratah Bay, near Digger's Island.) These may be either Silurian or Pre-silurian. To the east of headland, now being worked for lime, well-defined Silurian slates and sandstones outcrop on the strand. They are here nearly vertical. Still further to the east these Silurian sediments are seamed with quartz veins.

ECONOMIC VALUE OF THE LIMESTONE.

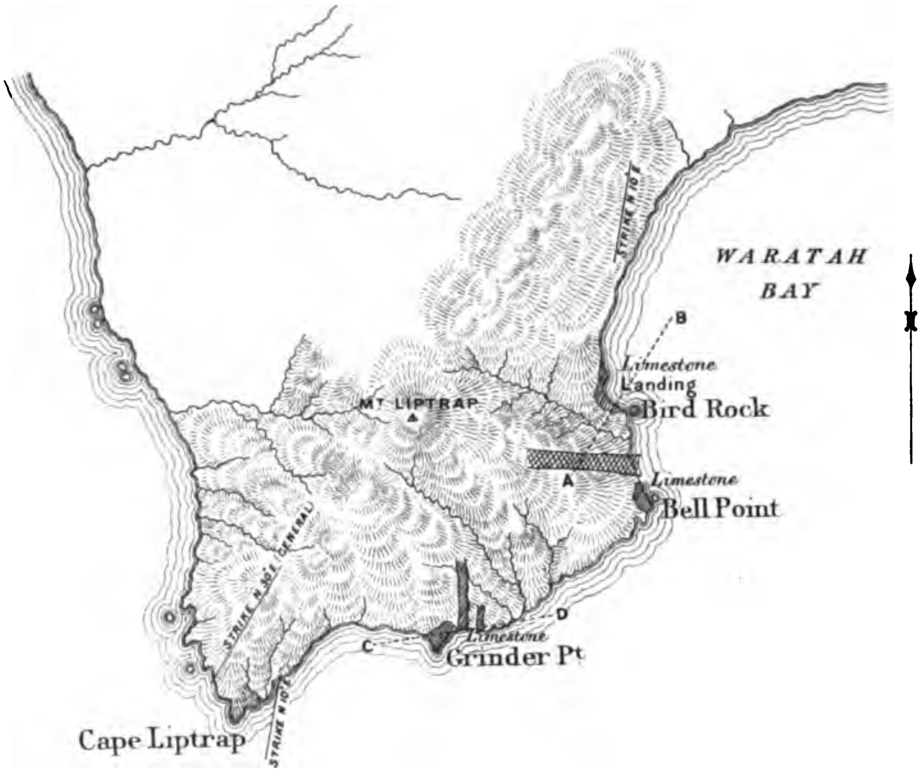
An estimate of the value of these limestone beds may be formed by noting the output of lime since 1878, viz., 1,000,774 bags, obtained from an area of about 2 acres. This, at 3s. 6d. per bag, less 1s. 3d. per bag for cost of production, yields the handsome sum of £112,588 19s. There is practically an unlimited supply yet available at Bell Point and Point Grinder. The kilns are well built, and every facility has been made for direct shipment. An analysis of the limestone gave—

Carbonate of lime ...	94·90	Described as a dense crystalline limestone (marble), which on burning gives a perfectly white lime.
Magnesia ...	traces	
Carbonate of iron ...	2·85	
Silica	2·25	
Water	0·5	

THE IGNEOUS ROCKS AND ASSOCIATED SILVER DEPOSITS.

To the west of Bird Rocks, igneous rocks intrude upon the sediments. This is known as gabbro; it has been described as consisting of plagioclase, with diallage from fine to coarse grained, the diallage changing into a mineral with the cleavage of hornblende—uralite. In places the coarse gabbro is traversed with serpentinous veins (see sketch section of serpentine dykes), and contains also in fissures

LOCALITY PLAN



SKETCH SECTIONS

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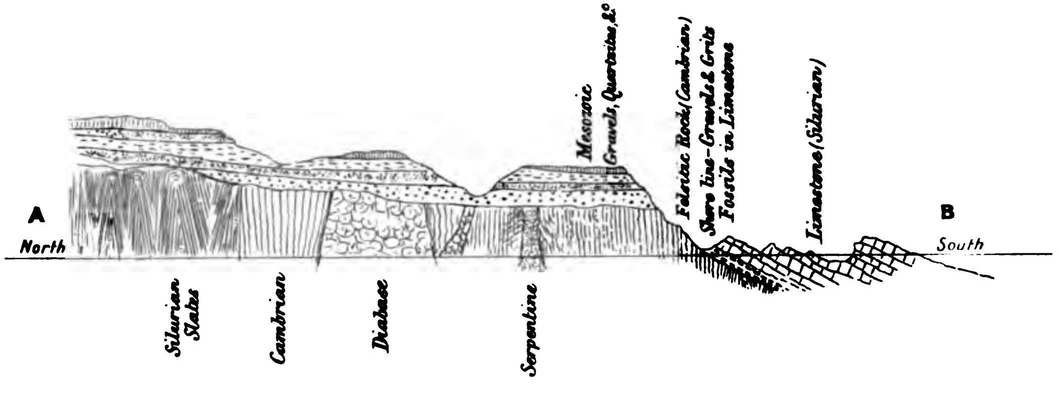

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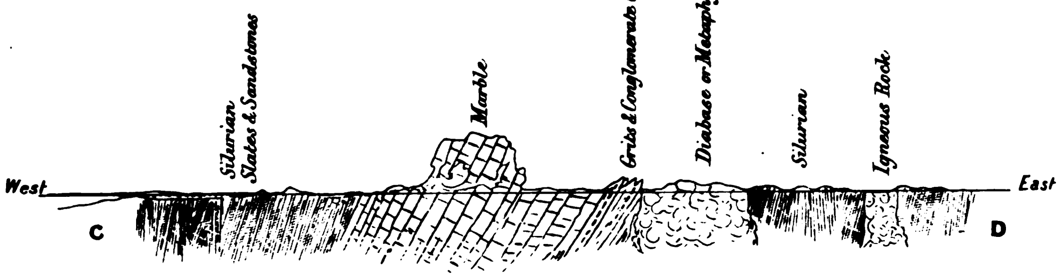
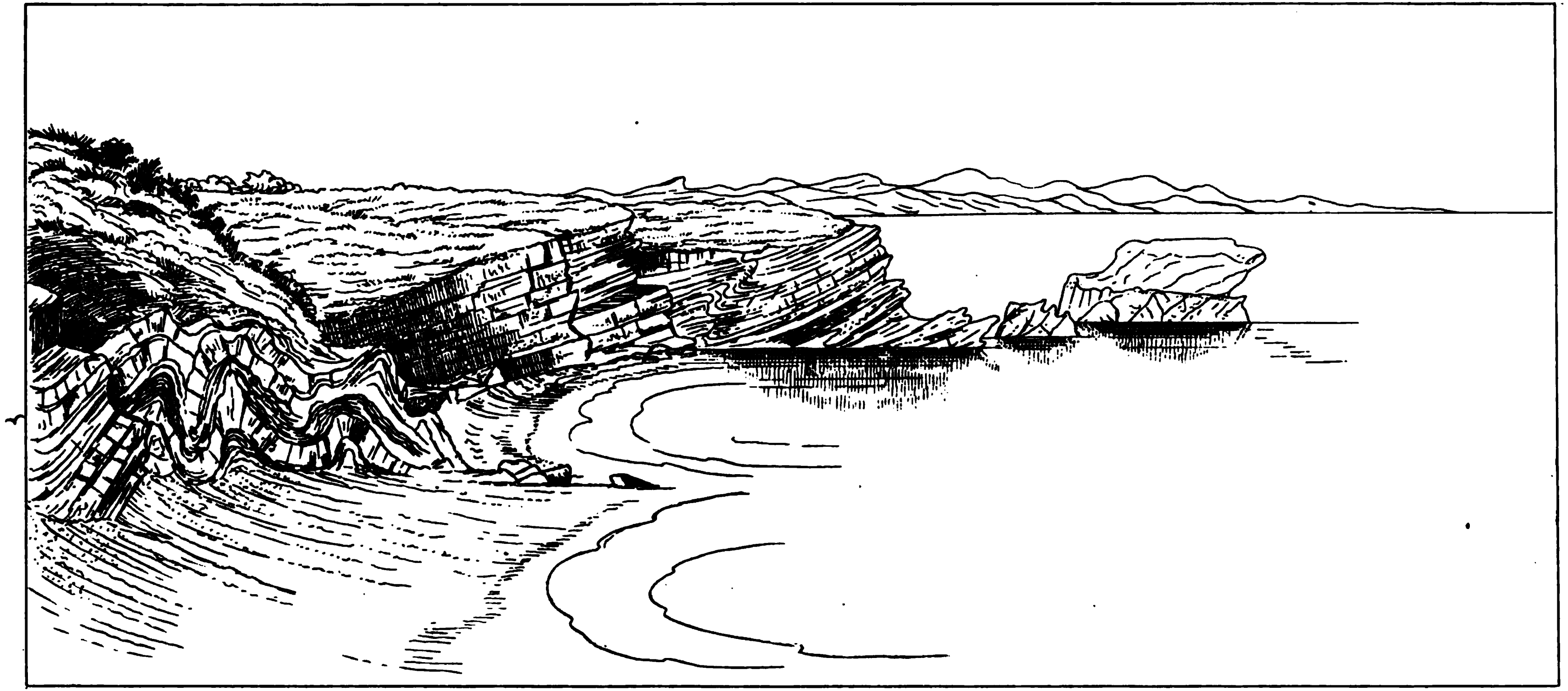
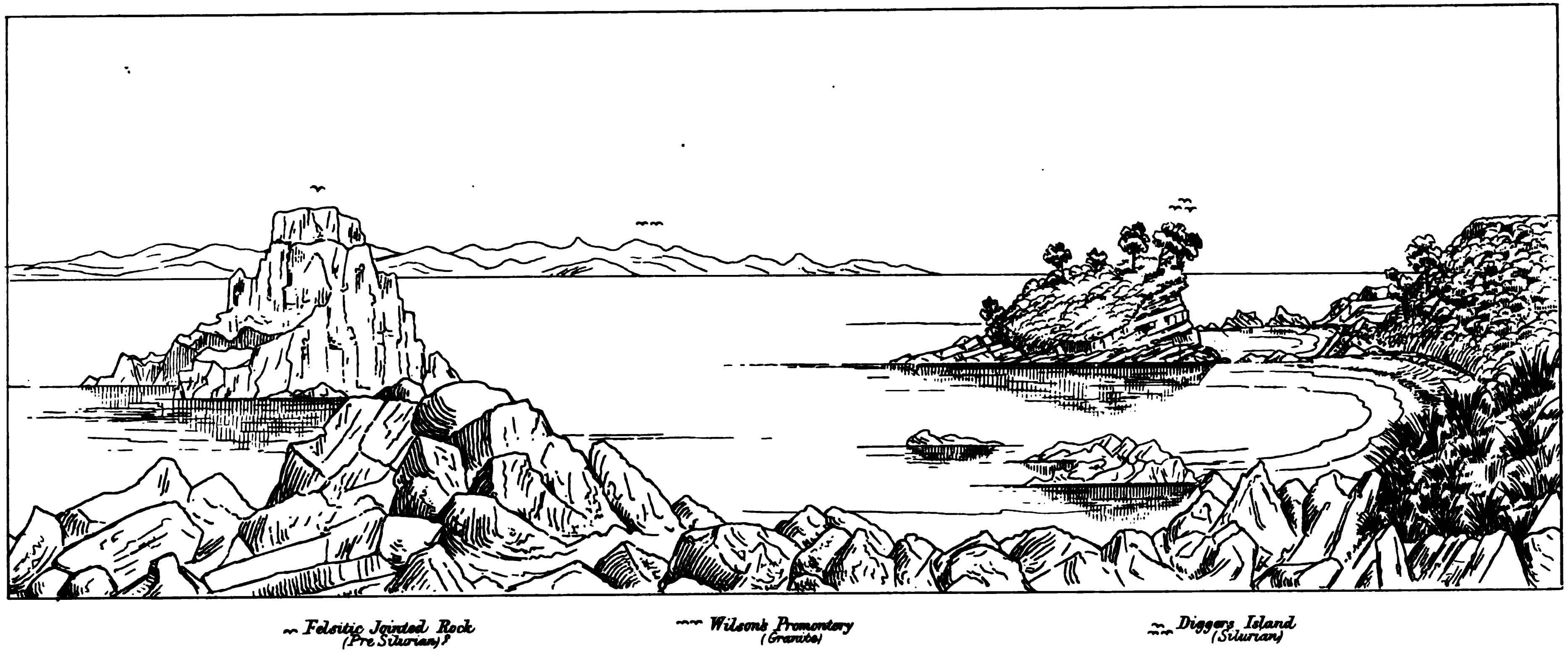


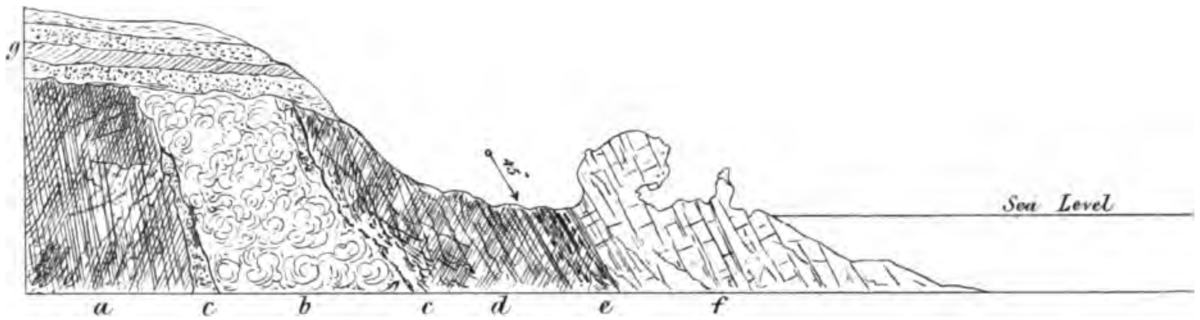


SKETCH OF BELL ROCK FROM THE WEST


Felsitic Jointed Rock (Pre Silurian)?
Wilson's Promontory (Granite)
Diggers Island (Silurian)

WARATAH BAY

SKETCH SECTION AT SERPENTINE DYKE TO WEST OF BIRD ROCK



a Jointed Felsitic Rock (Cambrian) b Serpentine. c Contact Rock (Mica Porphyrite) d Seams of Argentiferous Pyrites.
e Grits at base of Limestones. f Upper Silurian Limestone. g (Miocene) Gravels, Grits, Sandstones &c.

[illegible]

and cavities mammillary deposits in coatings of opaline silica; besides these there are inclusions of red and mottled felspar, also white fibrous radiating masses composed of lime, magnesia and iron carbonates, a ferruginous arragonite or else a brown spar.

It is in the bedding planes at the contact of the Silurian sediments and the gabbro or in the hornfels-like contact rocks that the thin seams of pyritous lode stuff containing a small percentage of silver were obtained as follows:—

Sample 177, quartz and iron pyrites, gave only a trace of gold.
Sample 178, slaty matter, containing iron pyrites and limestone, upon assay gave an amount of silver equal to 1oz. 6dwt. 3gr. of silver per ton of sample, and no gold.
Sample 179, decomposed gabbro, upon assay gave no gold or silver.
Sample 180, decomposed gabbro, upon assay gave no gold or silver.

The indications observed and analyses made do not justify a favorable report being submitted as to the payable character of the deposit, although it is not improbable that more payable lode stuff may hereafter be found by further prospecting near the contact of the igneous and sedimentary rocks.

From Bell Rock to Point Grinder, alternating masses of indurated Silurian sediments and dark amorphous igneous rocks are felted together in such a manner as to render it difficult to discern their stratigraphical relations. The igneous rocks resemble melaphyre and diabase.

It is not improbable that the gabbro and the diabasic rocks are associated with deep-seated apophyses from the granitic area of Wilson's Promontory to the S.E., and that the curvature of the limestone beds and associated strata is due to plutonic activities connected with great earth movements surrounding this intrusive area.

NOTES ON THE OCCURRENCE OF LIMESTONE AT MERRIMU.

(*By W. H. Ferguson.*)

I have the honour to submit a geologically-coloured plan, accompanied by notes and sections, relating to an occurrence of limestone at Merrimu. The lowest formation visible is the Lower Silurian, the ordinary slates and sandstones occur, the slates enclose the fossil, hymenocaris, and also graptolites. Large white glassy quartz reefs are numerous, and generally run east and west, while the strike of the Silurian rock bands is north and south. About 4 miles northwards from Coimadai township a lode containing gold and antimony is being worked; here the rocks strike east and west. No other reefs are being worked in the district, though the Crown lands around the antimony reef should repay prospecting. Some of the thicker sandstone beds yield a very serviceable building stone, which is used in local buildings. The glacial conglomerate occurs here at the surface; it is the same formation that is visible at Ballan, Bacchus Marsh, and the Lerderderg River. Here, as at Bald Hill, there has been a break in the strata; a section in Pyrete Sec. A. Creek shows the glacial conglomerate denuded and waterworn and unconformably covered by thin-bedded, fine silt, containing glaciated or striated stones. One boulder of granite was noticed in this upper deposit 2 feet in diameter, and the layers of rock had been laid down in a circular manner round the stone. The lower part of the conglomerate is a thick mass, which does not as a rule show much sign of stratification; but a section on Pyrete Creek shows bedded conglomerate considerably contorted. A fairly regular anti- Sec. B. clinal fold is to be seen; some of the dips taken were as high as 34° At Goodman's Creek there is a fine section of this formation—a cliff rises almost vertically for over 100 feet; part of it is traversed by a vertical decomposed dyke. A few chains higher up the creek than the cliff a heavy Post Pliocene wash, resting on the glacial conglomerate, is being worked for gold, and yields "wages" to a few men. The gold is probably derived from the Silurian rocks higher up the creek. At the Basin Creek there are several farms on the glacial conglomerate; it yields a good soil suitable for cultivation. The deposit of splendid hydraulic limestone for which Merrimu is famous rests on the glacial conglomerate. The formation consists of beds of limestone with thin partings of sand, clay, and gravel; it was probably laid down in a lake occupying a hollow in the glacial conglomerate, into which creeks brought down sand, clay, and fine quartz gravel, and the lime and magnesia may have been supplied by mineral springs flowing through the glacial conglomerate. The layers of limestone are much contorted, and it is rather difficult to account for these contortions. The limestone may be as old as the time when the conglomerate was disturbed, and the nature of the deposit, hard bands of limestone alternating with soft layers of clay and sand, would likely show more signs of strain and pressure than the massive and tough conglomerate. There is a decided unconformability between the limestone beds and the Miocene strata; a small patch of the latter formation caps the limestone. The Miocene rocks consist for the most part of gravel and sandy ironstone beds; the gravels are cemented together at some places by silica and at others by ferruginous matter. The effect of some chemical or physical force, as moist heat or pressure, has induced great change on the gravels, as they form a hard Silicious rock, and the outlines of the included pebbles often merge in the matrix. The ironstone layers pass under the basalt of the plain. They contain fragments of petrified wood resembling the Miocene fossiliferous ironstone formation at Bacchus Marsh. The beds of quartzite and altered quartz conglomerate occasionally rest directly on the Silurian rocks, and as they are of great extent they should be prospected for gold; as, if auriferous, from their large extent and accessibility, very little gold would repay the cost of working. In the bed of Pyrete Creek, just where the glacial conglomerate rests on the Sec. C. Silurian rocks, there is a spring of mineral water; it runs freely, and has a most pleasant and palatable taste, and it seems a pity that it is allowed to run to waste down the creek.

An examination of the old buildings of Coimadai shows that mortar made from the local lime turns to a hard stone, and will apparently outlast the bricks which it cements together. There is a considerable body of this fine lime. Two companies, who have large plants, with latest machinery for grinding and pulverizing the lime after it has passed through the kilns, are at present working the ground. Several small patches indicate that the deposit was formerly much larger, but has been mostly removed by denudation. There is probably a deposit of similar limestone of workable size about half-a-mile to the north-east of the kilns. Numerous fossils have been obtained from the workings; they are mostly bones of large animals. The Department is indebted to Mr. Robert Neeves, of Coimadai, for the presentation of two fine jaw-bones, with teeth in a good state of preservation, of an animal which is probably a species of *macropus* or extinct kangaroo. The formation was from the stratigraphical and palæontological evidence most likely deposited in the Lower Tertiary or Eocene period, and somewhat resembles the strata of the Paris basin.

REPORT ON AGNES RIVER TIN MINING DISTRICT.

(*By James Stirling, Assistant Geological Surveyor.*)

The Agnes River alluvial tin deposits are described as occupying a trough in the Mesozoic strata between the Agnes and Franklin Rivers, about three miles north of the township of Toora, on the Great Southern Railway. The physical features at Toora are referred to as rich alluvial flats, stretching from the undulating and steep slopes of the Mesozoic spurs, which proceed from the watershed line dividing the Agnes and Franklin Rivers to Corner Inlet, about one mile distant. Near the latter the flats merge into estuarine mud flats, covered with ti-tree (*Melaleuca ericifolia*) and the mangrove *Avicemia tomentosa.* It is remarked that, while the hills between the tin deposits and Toora are admirably suited for dairy farms, the rich alluvial flats are well suited for agriculture. It is also pointed out that the locality seems admirably suited for village settlement should the developments of mining continue, and in connexion with the fishing industry at Corner Inlet.

The Tin Drifts.

An approximate estimate of the area over which workable tin drifts occur is given as 260 acres, with an average depth of 50 feet. From various analyses of the stanniferous material it is estimated that an amount equal to 7 lbs. per ton of stuff could be won by hydraulic sluicing.

The character of the drift shows it to be derived from the denudation of granite, as not only the quartz grains composing the greater part of the drift, but several mineral substances, such as schorl, pleonaste, zircon, garnet, &c., are to be found in the granite country at Yanakie and Wilson's Promontory to the south, from whence it is inferred the stanniferous materials were derived. A percentage of gold is also found associated with the tin deposits. This, it is believed, has been derived from the denudation of the Silurian country to the south-west, towards Shallow Inlet and Waratah Bay. Analyses gave gold in drift equal to 8 grains per ton. The race, which has been cut to a source of perennial supply on the Franklin River for a length of 12 miles and 23 chains (and which is 2ft. 5in. in depth, and 2ft. 6in. in bottom), has been excavated from sandstones and shales, which dip on an average 10° to S.W. Pieces of carbonized wood occur along with imprints of such characteristic coal plants as sphenopteris and tæniopteris in the sandstones and shales. To the south of the area occupied by the tin drifts, the beds of sandstone are nearly horizontal, dipping, as in Harkins' selection, 4° N. to 40° W.; but as the terminations of the spurs are approached towards Toora, as in Shepherd's paddock, the beds are highly inclined from 10° to 30° S.W. This ridging up of the Jurassic sediments along their margin is noticeable to the west, as in the railway cuttings west of Foster, on the Hoddle Range.

Referring to the machinery erected to treat the stuff, it is remarked that, notwithstanding the substantial character of the former, it is questionable if sufficient stuff could be treated by the revolving screen and other appliances to yield satisfactory results,

The features disclosed by the workings on the fall towards the Franklin River, in lease block No. 1152, are described as consisting of Jurassic bed-rock, shales, and sandstones, with occasional flakes and patches of carbonaceous matter, on which rests a deposit of stiff blue tenacious clay, with bands of impure lignite very much decomposed, about 3ft. 6in. thick; then 6 feet of yellowish clay in parts ferruginous; then deposits of coarse gravels and grit (with subordinate clay seams) 4ft. 6in. thick. Above this alternating deposits of grits, sandy clays, and then irregular seams containing an abundance of schorl crystals. Some of the latter are ½ inch long, and one-eighth of an inch in diameter; the stanniferous materials occurring throughout the whole extent of the deposit (but in parts more or less associated with titaniferous iron sand) to a thickness of 20 feet. It is remarked that as the hillside is sluiced away, the deposits will probably thicken to the north-east; the bed or floor of the deposit dipping in that direction. Samples panned off from different levels on the face gave several pennyweights of tin, with colours of gold, to the dish.

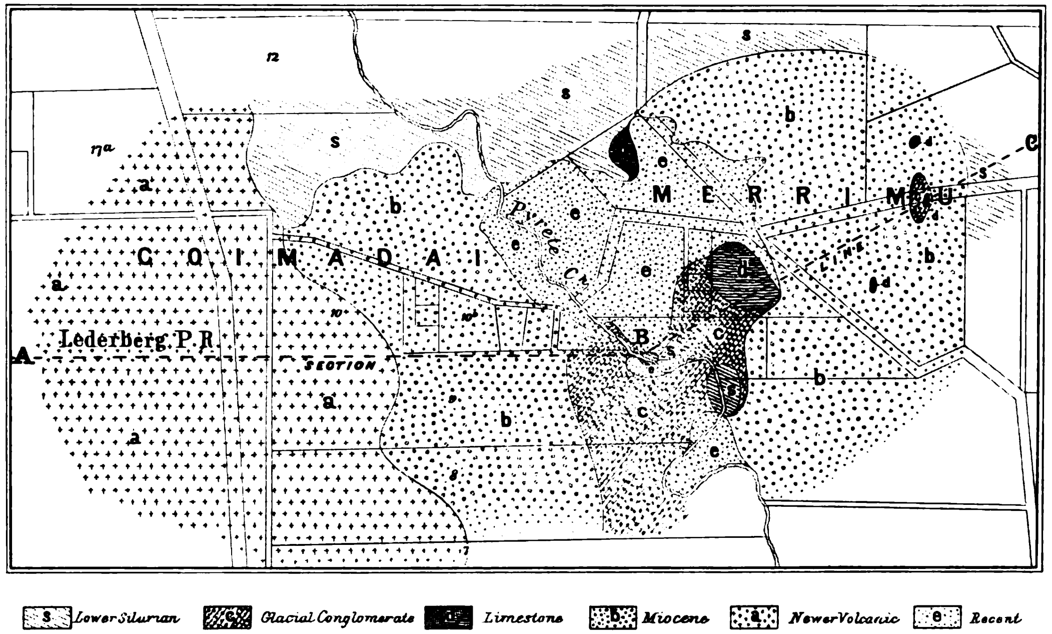
The exact boundaries of the wash has not yet been surveyed. There are evidences in the topographic features of faultings (landslips) or displacements of the deposit, which covers most of the areas held under lease.

In summarizing the results of observations it is remarked that, with a sufficiency of water made available, the opening out of a face on the fall towards the Agnes River, where less iron sand occurs in the drifts, and more efficient machinery for concentrating the gravels, and proper economy of management, there seems no reason to doubt the ultimate success of mining operations. It is believed that the known extent of the stanniferous area, its depth and richness, are indicative of a payable field for alluvial tin mining. The age of the deposit is classed as Pliocene, or of same age as the auriferous gravels of Foster to the west.

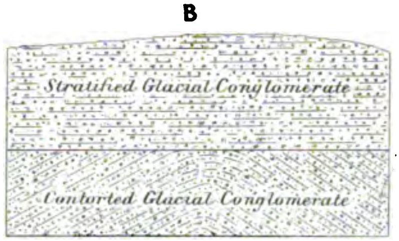
OCCURRENCE OF LIMESTONE—PARISH OF MERRIMU

Locality Plan

Scale. 40 Chs to an inch.

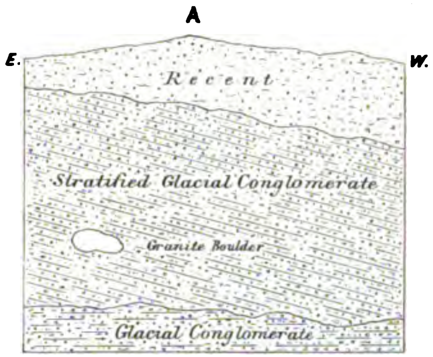


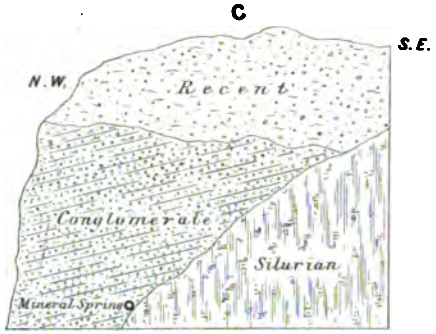
Sections



B
Stratified Glacial Conglomerate
Contorted Glacial Conglomerate

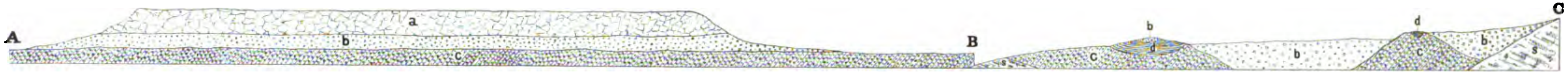
Scales. Hor & Ver. 66 Ft to 1 inch





Scales. Hor. & Ver. 10 Feet to 1 inch.

Section along Line A.B.C.



Scales. { Hor. 20 Chains to One inch.
Ver. 660 Feet " "

PLATE No. I

SKETCH SECTION OF SAND DUNES
at entrance to
SHALLOW INLET

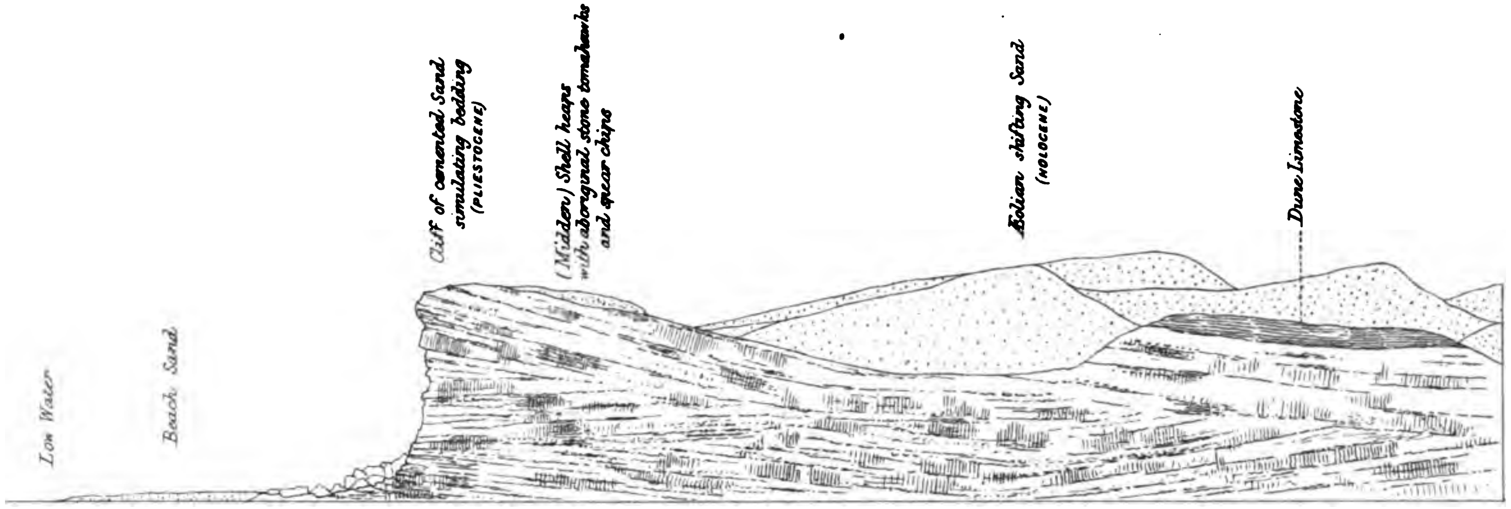

Low Water
Beach Sand
Cliff of cemented Sand simulating bedding (PLIESTOCENE)
(Midden) Shell heaps with aboriginal stone tomahawks and spear chips
Æolian shifting Sand (HOLOCENE)
Dune Limestone

PLATE No. 2

SKETCH SECTION

to shew

outcrops of Peaty beds along Coast Line and their mode of occurrence in relation to accumulations in progress

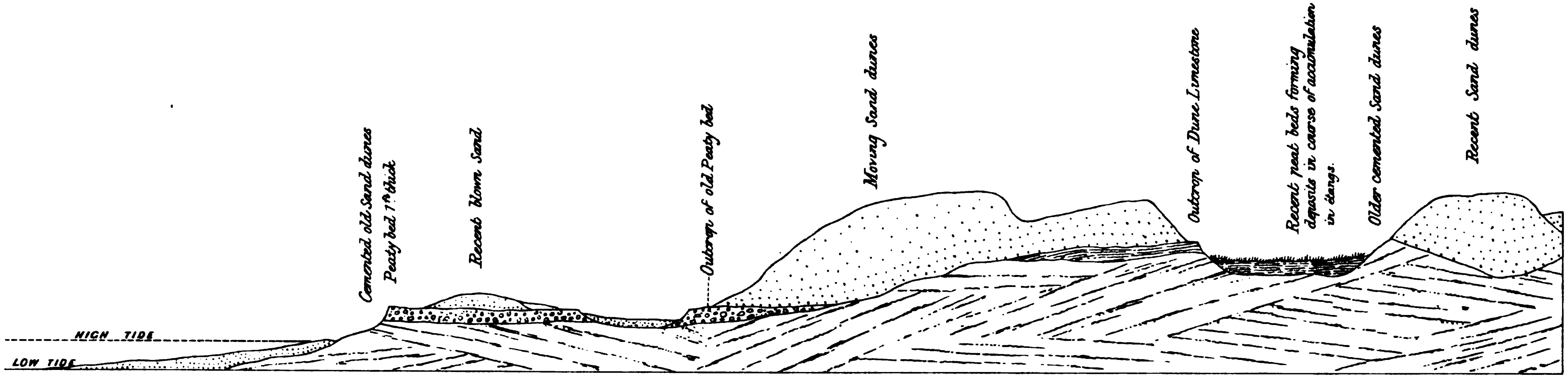
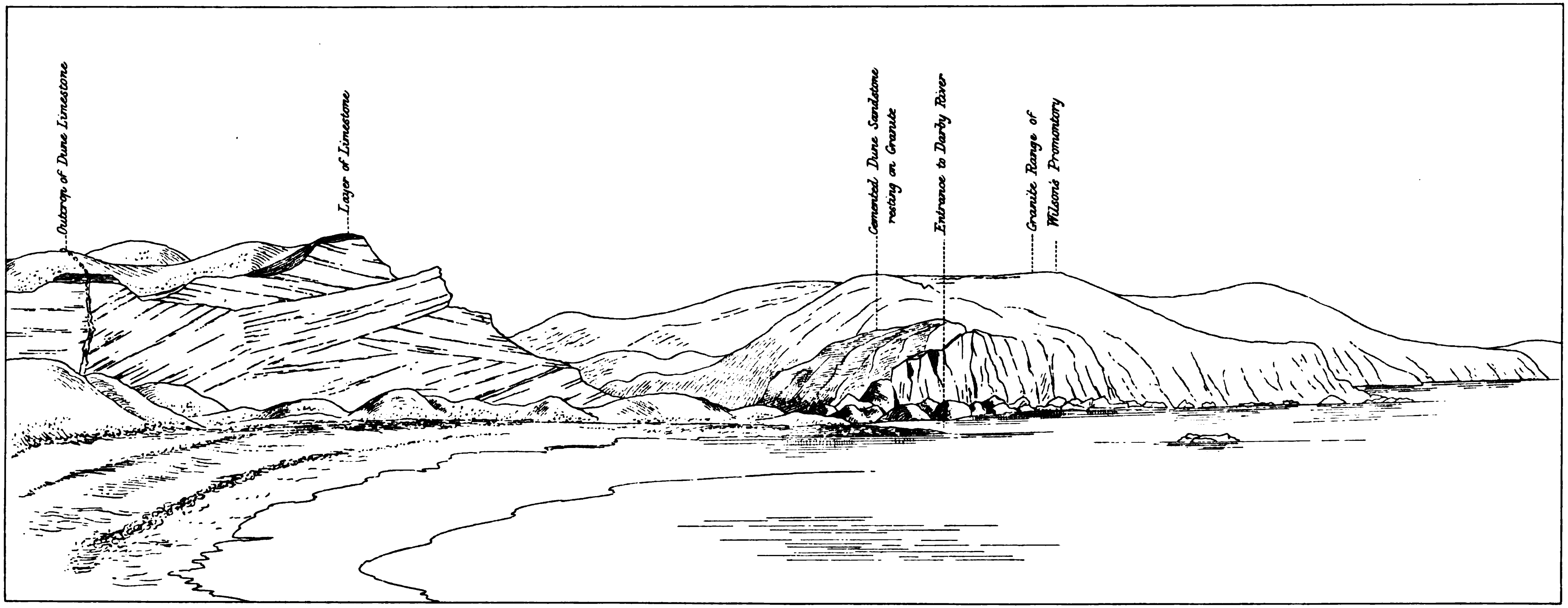
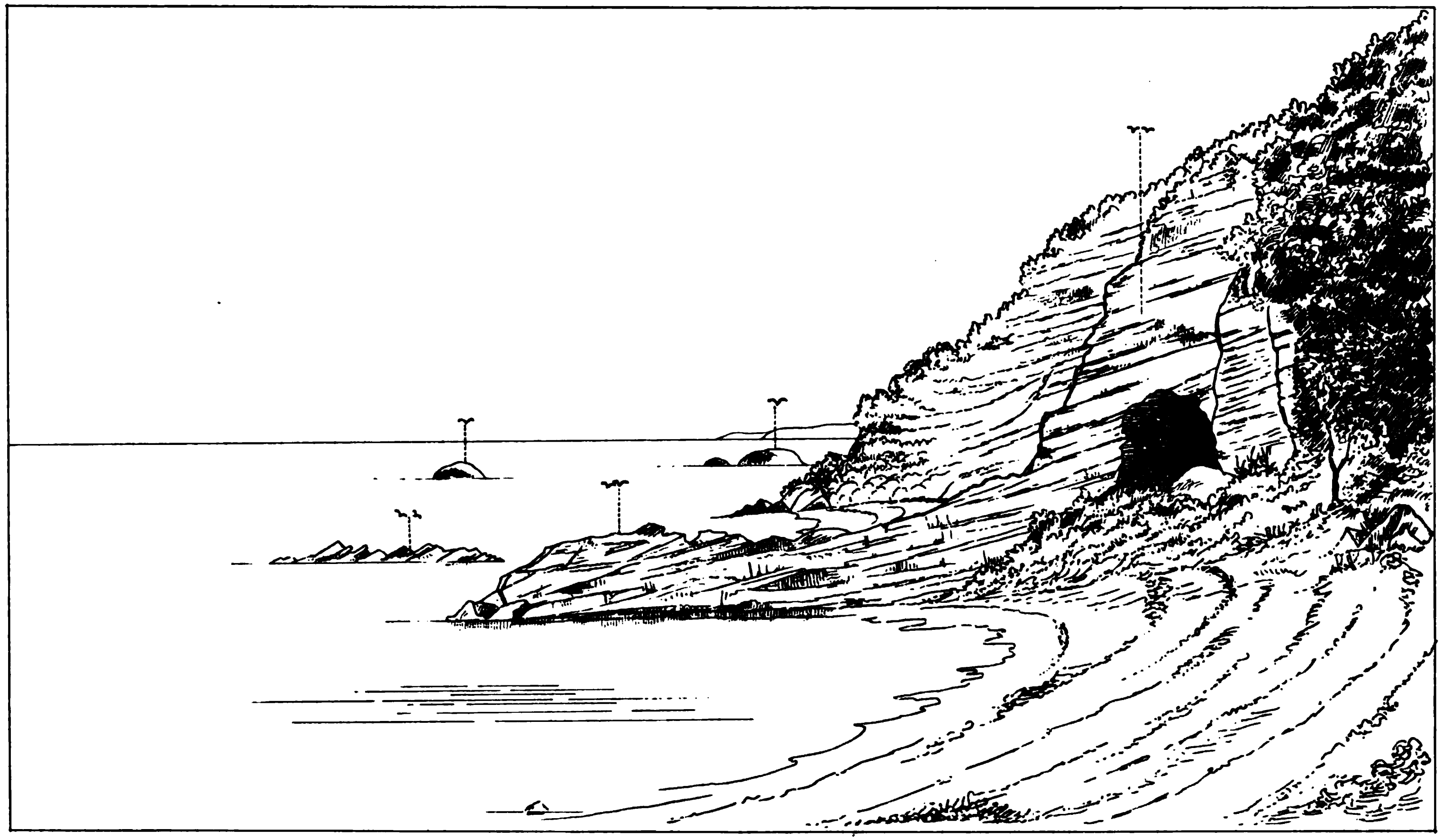


PLATE No. 3


Outcrop of Dune Limestone
Layer of Limestone
Cemented Dune Sandstone resting on Granite
Entrance to Darby River
Granite Range of Wilson's Promontory

SKETCH SHEWING OLD CEMENTED SAND DUNES AT WILSON'S PROMONTORY & THE ENTRANCE TO DARBY RIVER [illegible] [illegible]

PLATE Nº 4



SILURIAN OUTCROP NEAR JUNCTION WITH GRANITE, YANAKIE.

[illegible]

The general geology of the area at Toora, and also the country to the south-west and across Corner Inlet towards Wilson's Promontory, from whence the stanniferous materials are believed to have been derived, is referred to as follows :—

HOLOCENE AND PLEISTOCENE.

Excavation made for brick clays at Toora, near base of foot-hills, gave the following :—

1 foot—Dark-grey surface soil.
6 feet—Whitish loamy clay, with small pieces of charcoal coated with iron, giving a pisolitic appearance to the latter ; where the clay is burnt these charcoal inclusions leave hollows in the bricks, which slag under great heat.
2 feet—Yellowish tough clay, with occasional pieces of quartz grit and flakes of indurated slaty rock ; these angular chips resemble blackfellow flakes for scraping weapons.
1 foot—Gravelly wash—probably a creek channel.
3 feet—Tough puggy clay—somewhat laminated.
feet—Undetermined, but probably clays and grits resting on Jurassic sandstone.

The sand dunes which cover the neck of land to the south of Yanakie, and between Corner Inlet and Waratah Bay, are described as Holocene, Pleistocene, and Pliocene, as follows :—

A series of parallel sand ridges, trending between N. 75° E. to N. 85° E. ; slopes of shifting sand, 28° to 32° on east and north sides, while those covered with shrubs slope 35° on north and 38° on south side ; the steepness of slope on the leeward side depending on the velocity of the wind and the consolidation of the sand grains after rainfall. These shifting sands are classed as Holocene. Sections observed along the beach from Shallow Inlet to the entrance of the Darby River, at Wilson's Promontory (see plate No. 1), gave the following interesting features :—

At entrance to Shallow Inlet the cliffs on eastern side are made up of cemented sand dunes, simulating aqueous false bedding to a depth of 20 feet. On the top of cliff are heaps of shell "midden" of the aborigines, near which stone tomahawks and numerous flakes were found. The former are of the same pattern as those made by the surviving Kurnai of Gippsland, and are made from the aphanitic greenstone of Waratah Bay. The latter are chipped from nodules of an opaline silica. The shells are mainly representatives of turbo and mactra. As these middens, although formed on the somewhat smoothed surface of the cemented sand dunes, are in places covered by the recent blown sand, they may provisionally be classed as Later Pleistocene. Until the rate of translation of the shifting sands can be more accurately determined the age of the middens cannot satisfactorily be fixed. Following the coast line towards the promontory, outcrops of black greasy soils are seen beneath the shifting sands. About 10 or 12 feet above high water these deposits are from a few inches to 2 feet in thickness, and contain numerous sub-fossil shells—*paludina*. They appear to represent the beds of old étangs between the sand dunes of the older period, now exposed by the encroachments of the sea, and are classed as Early Pleistocene. (See plate No. 2.) On the ridges of cemented sand dunes bands of dune limestone are frequent, forming cappings from a few inches to several feet in thickness. In places these dune limestones stand up as vertical layers, running parallel with the general trend of the hummocks ; in such cases they are evidently formed by the percolation of water holding lime in solution down shrinkage cracks in the cemented sand dunes. A noticeable instance of this is seen in the section observed near the Darby River. (See Plate No. 3.) Were it not that there is an entire absence of any shales or gravel beds in the cemented sand dunes—so much do they simulate aqueous deposits and ripple marks of tidal accumulations—that it is difficult to resist the impression that they are really aqueous and not of æolion origin. These cemented or older sand dunes may be classed as Newer Pliocene. On the Darby River are alluvial flats. These fluviatile deposits are older than the moving sand dunes and younger than the cemented dunes, and are therefore classed as Pleistocene. It must be borne in mind, however, that in all probability the different deposits are continuous, varying with the climatic conditions, so that any classification is more or less arbitrary, although a chronological sequence may be traced out ; the growth of vegetation in favoured localities arresting the moving sands, while at others the translation of the sand has been continuous. In some localities the dune limestone has weathered into a chocolate soil, while many of the depressions between the ridges where water has accumulated is covered with a dense herbage. The sand carecis, *spinifex hirsutæ*, and *distichus maritima* assist the moving sands and form a nidus for the seeds of *titragonias atriplex* and *misembryanthemum* to germinate.

SILURIAN.

Referring to the Silurian rocks which intervene between Yanakie and the Mesozoic hills of the Franklin River, it is remarked that the junction of the granite with the former is seen to the north of Miller's landing at Yanakie or Corner Inlet (see plate No. 4), and that the sedimentary rocks are lithologically similar to Upper Silurian rocks. To the north and north-east of Shallow Inlet the low foothills of Silurian rock are covered with a coarse gravelly drift, said to contain gold. They would appear to have been extensively denuded, from the intervening country between the head of Shallow Inlet and the sand dunes east of Yanakie. So far as could be determined from a cursory examination these deposits are probably Later Pliocene, and are probably connected with the auriferous gravels at Foster.

THE GRANITE.

Yanakie and Wilson's Promontory.

The low undulating hills at Yanakie, covered with heath-like plants, and the flat, swampy depressions, covered with melaleuca and galenia, &c., are seen to be covered with a granitic drift in places, overlying a very coarse grey granite, presenting the following microscopic characters :—Large macles of felspar, amorphous quartz, and biotite, with some accumulated hornblende and tourmaline. The felspars are mainly orthoclastic ; large crystals, fully 3 inches long by 1 inch broad, are numerous. In many cases the quartz forms with the felspar a micro-granitic structure. In places where the granite is fine-grained, it contains patches of garnetiferous rock ; in others it is full of minute prisms of tourmaline or of hornblende, while veins and patches of pegmatite, composed of quartz and muscovite mica, are frequent.

Mr. Millar, of Yanakie, having informed me that he had obtained samples of tin in the gravelly wash overlying this granite near the Yanakie landing, and also gold, I tried several places, and found undoubted traces of both tin and gold. In washing or panning-off the sand close to the granitic outcrops near the landing, a copious supply of ruby garnets were obtained, and on breaking open the rocks close by the garnets were obtained *in situ*.

In concluding the report, it is remarked that, although there are evidences that the Toora tin drifts are derived from the disintegration of granites similar to those of Yanakie and Wilson's Promontory, yet sufficient data to work out the geological history of the period of their deposition along the flanks of the Mount Fatigue Ranges has not yet been obtained. At present the waters of Corner Inlet cover what was, probably, during early Pliocene times a connected land surface, extensive denudation or a depression has lowered the country intervening between Yanakie and the Toora or Agnes River tin deposits. And whether such was due to ordinary pluvial or marine conditions, or whether glaciation played a part in the evolution of existing physical features, separating the tin drifts from the stanniferous matrices, remains to be determined by more detailed geological surveys over a larger area. Another important question which awaits solution by such surveys is as to the presence of stanniferous lodes within the area known as Wilson's Promontory, or whether the tin occurring in the drifts has been merely disseminated through the granite in a similar manner to the schorl or garnet crystals. It is pointed out that the problems arising out of an examination and study of the physical geology of this portion of South Gippsland, or from Wilson's Promontory to Waratah Bay (Cape Liptrap), and north-easterly to Foster, and easterly to Toora, are of the highest scientific and economic importance.

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